

1.0 Title and Approval Page

Document Title: Volunteer River Assessment Program
Quality Assurance Project Plan

Lead Organization: Water Quality Planning Section

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Note: EPA review is not mandatory, since this project is state-funded, and does not receive funds from EPA

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Appendix A: VRAP Field Sampling Protocols; Hydrolab DataSonde 4a SOP; Fixed Laboratory SOPs

Appendix B: SAP Template

Appendix C: Field data sheet, Station ID form, NHDES laboratory login/custody sheet, NHDES laboratory results sheet, Field TSA sheet, Verification/Validation log sheet, Equipment maintenance log sheet

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2.2 Document Control Format

The document control format is shown in the upper right hand corner of each page of this QAPP.

2.3 Document Control Numbering System

The revision number provided in the upper right hand corner of this QAPP is the basis for the document control numbering system of this QAPP. Recipients of copies of this QAPP are listed in Table 1 in Section 3.0. The Program Manager retains the controlled copy of this QAPP.

2.3 EPA-NE QAPP Worksheet #2

Please see the next page for Worksheet #2.

2.4 EPA-NE QAPP Worksheet #2

1. Identify Guidance used to prepare QAPP:

Format and content: Region I, EPA-NE Compendium of QAPP Requirements and Guidance, Final October 1999, and Attachment A, Region I, EPA-NE QAPP Manual. Draft, September, 1998.

Scale of content: EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5. Interim final, November, 1999.

2. Identify EPA Program: No specific EPA program, but data are applicable to Clean Water Act, Section 303(d) and 305(b), Surface Water Program

3. Identify approval entity: EPA-NE, State, or other: NH Department of Environmental Services

4. Indicate whether the QAPP is a generic program QAPP or a project specific QAPP. (underline one)

5. List dates of scoping meetings that were held: Various dates during Winter 2002-2003.

6. List title of QAPP documents and approval dates written for previous site work, if applicable:

Cocheco River VRAP QAPP - 1999

7. List organizational partners (stakeholders) and connection with EPA and/or State:

None

8. List data users:

The Government and General Public of the State of New Hampshire

U.S. Environmental Protection Agency

9. If any required QAPP Elements (1-20), Worksheets and/or Required Information are not applicable the project, then circle the omitted QAPP Elements, Worksheets and Required Information on the attached Table. Provide an explanation for their exclusion below:

All QAPP elements are included in the Volunteer River Monitoring Program QAPP.

Required EPA QA/R-5 QAPP Elements	Required EPA-NE QAPP Elements and Corresponding EPA-NE QAPP Sections	EPA-NE QAPP Worksheet #	Required Information
Project Management and Objectives			
A1	1.0 Title and Approval Page	1	-Title and Approval Page
A2	2.0 Table of Contents and Document Format 2.1 Table of Contents 2.2 Document Control Format 2.3 Document Control Numbering System 2.4 EPA-NE QAPP Worksheet #2	2	-Table of Contents -EPA-NE QAPP Worksheet
A3	3.0 Distribution List and Project Personnel Sign-off Sheet	3 4	-Distribution List -Project Personnel Sign-off Sheet
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A5	5.0 Project Planning/Project Definition 5.1 Project Planning Meetings 5.2 Problem Definition/Site History and Background	8a 8b	-Project Scoping Meeting Attendance Sheet with Agenda and other Project Planning Meeting Documentation -Problem Definition/Site History and Background -EPA-NE DQO Summary Form -Site Maps (historical and present)
A6	6.0 Project Description and Schedule 6.1 Project Overview 6.2 Project Schedule	9a 9b 9c 9d 10	-Project Description -Contaminants of Concern and Other Target Analytes Table -Field and Quality Control Sample Summary Table -Analytical Services Table -System Designs -Project Schedule Timeline Table
A7	7.0 Project Quality Objectives and Measurement Performance Criteria 7.1 Project Quality Objectives 7.2 Measurement Performance Criteria	11a 11b	-Project Quality Objectives/Decision Statements -Measurement Performance Criteria Table
Measurement/Data Acquisition			
B1	8.0 Sampling Process Design 8.1 Sampling Design Rationale	12a 12b	-Sampling Design and Rationale -Sampling Locations, Sampling and Analysis Method/SOP Requirements Table -Sample Location Map

Required EPA QA/R-5 QAPP Elements	Required EPA-NE QAPP Elements and Corresponding EPA-NE QAPP Sections	EPA-NE QAPP Worksheet #	Required Information
B2, B6, B7, B8	9.0 Sampling Procedures and Requirements 9.1 Sampling Procedures 9.2 Sampling SOP Modifications 9.3 Cleaning and Decontamination of Equipment/Sample Containers 9.4 Field Equipment Calibration 9.5 Field Equipment Maintenance, Testing and Inspection Requirements 9.6 Inspection and Acceptance Requirements for Supplies/Sample Containers	13 12b 14 15	-Sampling SOPs -Project Sampling SOP Reference Table -Sampling Container, Volumes and Preservation Table -Field Sampling Equipment Calibration Table -Cleaning and Decontamination SOPs -Field Equipment Maintenance, Testing and Inspection Table
B3	10.0 Sample Handling, Tracking and Custody Requirements 10.1 Sample Collection Documentation 10.1.1 Field Notes 10.1.2 Field Documentation Management System 10.2 Sample Handling and Tracking System 10.3 Sample Custody	16	-Sample Handling, Tracking and Custody SOPs -Sample Handling Flow Diagram -Sample Container Label (Sample Tag) -Chain-of-Custody Form and Seal
B4, B6, B7, B8	11.0 Field Analytical Method Requirements 11.1 Field Analytical Methods and SOPs 11.2 Field Analytical Method/SOP Modifications 11.3 Field Analytical Instrument Calibration 11.4 Field Analytical Instrument/Equipment Maintenance, Testing and Inspection Requirements 11.5 Field Analytical Inspection and Acceptance Requirements for Supplies	17 18 19	-Field Analytical Methods/SOPs -Field Analytical Method/SOP Reference Table -Field Analytical Instrument Calibration Table -Field Analytical Instrument/Equipment Maintenance, Testing and Inspection Table

Required EPA QA/R-5 QAPP Elements	Required EPA-NE QAPP Elements and Corresponding EPA-NE QAPP Sections	EPA-NE QAPP Worksheet #	Required Information
B4, B6, B7, B8	12.0 Fixed Laboratory Analytical Method Requirements 12.1 Fixed Laboratory Analytical Methods and SOPs 12.2 Fixed Laboratory Analytical Method/SOP Modifications 12.3 Fixed Laboratory Instrument Calibration 12.4 Fixed Laboratory Instrument/ Equipment Maintenance, Testing and Inspection Requirements 12.5 Fixed Laboratory Inspection and Acceptance Requirements for Supplies	20 21	-Fixed Laboratory Analytical Methods/SOPs -Fixed Laboratory Analytical Method/SOP Reference Table -Fixed Laboratory Instrument Maintenance and Calibration Table
B5	13.0 Quality Control Requirements 13.1 Sampling Quality Control 13.2 Analytical Quality Control 13.2.1 Field Analytical QC 13.2.2 Fixed Laboratory QC	22a 22b 23a 23b 24a 24b	Sampling - Field Sampling QC Table - Field Sampling QC Table cont. Analytical - Field Analytical QC Table - Field Analytical QC Table cont. - Field Screening/Confirmatory Analysis Decision Tree - Fixed Laboratory Analytical QC Sample Table - Fixed Laboratory Analytical QC Sample Table cont.
B9	14.0 Data Acquisition Requirements	25	-Non-Direct Measurements Criteria and Limitations Table
A9, B10	15.0 Documentation, Records and Data Management 15.1 Project Documentation and Records 15.2 Field Analysis Data Package Deliverables 15.3 Fixed Laboratory Data Package Deliverables 15.4 Data Reporting Formats 15.5 Data Handling and Management 15.6 Data Tracking and Control	26	-Project Documentation and Records Table -Data Management SOPs

Required EPA QA/R-5 QAPP Elements	Required EPA-NE QAPP Elements and Corresponding EPA-NE QAPP Sections	EPA-NE QAPP Worksheet #	Required Information
Assessment/Oversight			
C1	16.0 Assessments and Response Actions 16.1 Planned Assessments 16.2 Assessment Findings and Corrective Action Responses 16.3 Additional QAPP Non-Conformances	27a 27b 27c	-Assessment and Response Actions -Project Assessment Table -Project Assessment Plan -Audit Checklists
C2	17.0 QA Management Reports	28	-QA Management Reports Table
Data Validation and Usability			
D1	18.0 Verification and Validation Requirements		-Validation Criteria Documents
D2	19.0 Verification and Validation Procedures	29a 29b 29c	-Data Evaluation Process -Data Validation Summary Table -Data Validation Modifications
D3	20.0 Data Usability/Reconciliation with Project Quality Objectives	30	-Data Usability Assessment

3.0 Distribution List and Project Personnel Sign-off Sheet

Table 1 shows all individuals receiving the approved QAPP, the QAPP revisions, and any amendments. The Title and Approval Page of this document serves as the project personnel sign-off sheet.

Table 1. QAPP Distribution List

QAPP Recipient Name	Title	Organization	Telephone Number
Vincent Perelli	NHDES Quality Assurance Manager	NHDES Planning Unit	603-271-8989
Dick Siscanaw	USEPA QA Officer	USEPA New England	617-918-8327
Rachel Rainey	Laboratory QA Officer	NHDES Laboratory	603-271-2993
Ted Walsh	Program Manager	NHDES – Watershed Management Bureau	603-271-2083

Based on EPA-NE Worksheet #3

Note: The QAPP is also distributed to VRAP volunteer groups, upon request.

4.0 Project Organization

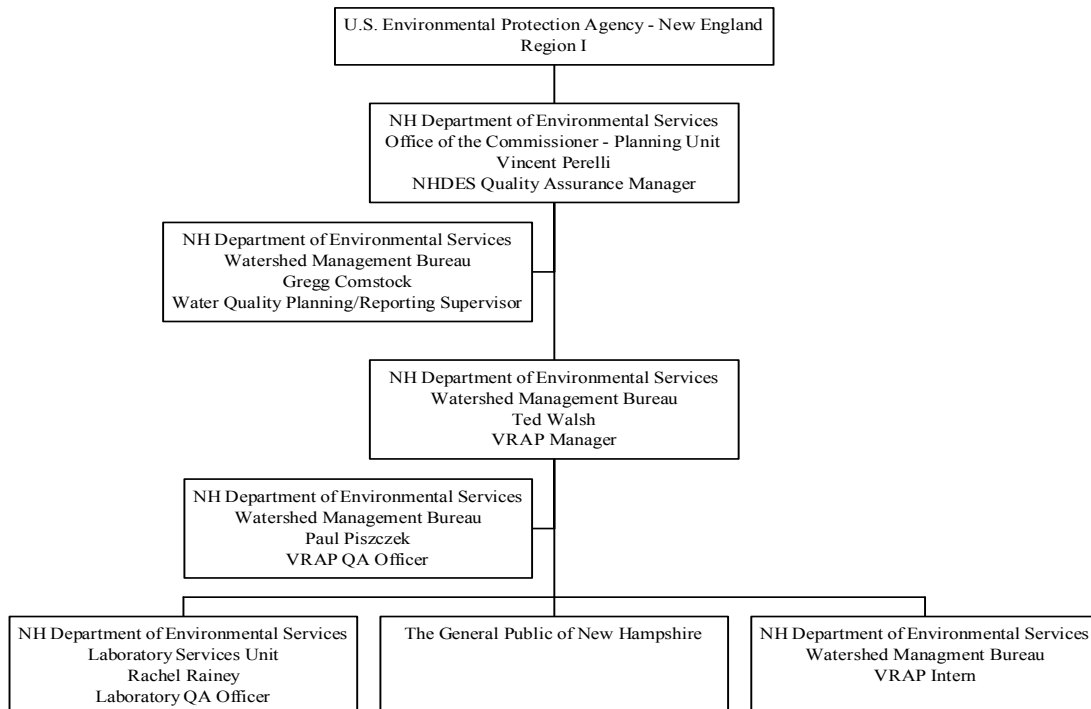
This section identifies the organizations and key personnel participating in the project and describes their specific roles, responsibilities, and qualifications. This section also explains communication pathways.

4.1 Project Organization Description and Chart

The Volunteer River Assessment Program (VRAP) is conducted through the NHDES Watershed Management Bureau, using staff of the Water Quality Planning Section (Figure 1). Ted Walsh is the VRAP Manager, and is the point of contact for all VRAP-related activities. Paul Piszczek is the VRAP QA Officer, and is responsible for preparing and revising the VRAP QAPP. A full-time, temporary VRAP intern (three to six months during each monitoring year) assists the Program Manager with all day-to-day VRAP activities. The Program Manager collaborates with Watershed Management Bureau staff in the design and implementation of the program during summer 2003, including the selection of sampling locations and logistical planning. The Program Manager, Program QA Officer, and/or Water Quality Planning Section staff trains all VRAP participants (volunteers) in proper water sampling, field analysis techniques, and field documentation procedures. Volunteers are usually part of a local watershed group, and are responsible for field data collection. Water Quality Planning Section staff are responsible for entering volunteer-collected data into the NHDES water quality database (STORET compatible). NHDES laboratory personnel are responsible for analyzing water samples for bacteria, nutrients, and metals. Rachel Rainey, NHDES Laboratory Services Unit, is the Laboratory QA Officer, and is responsible for reviewing and revising laboratory-related elements of the QAPP. The Laboratory QA Officer also oversees QAPP implementation in the laboratory.

Water Quality Planning Section staff are responsible for compiling and analyzing data for decision-making purposes. Data are used by local, state, and federal governments for identifying water pollution areas. In addition, the data are used in the federal 303(d) list and 305(b) report. Other data users include staff of the U.S. Environmental Protection Agency and the general public.

Figure 1. Organizational chart for the NHDES Volunteer River Assessment Program.



4.2 Communication Pathways

The Program Manager is the primary contact for all staff involved with VRAP. Dialogue exists between the Program Manager and Watershed Management Bureau staff regarding the design and implementation of the program. The Program Manager provides direction to the Intern and volunteers throughout the data collection period, and is notified of any problems associated with data collection and/or analysis. Further direction is given to the Intern for data entry. In consultation with the Laboratory QA Officer, the Program Manager delegates corrective actions. Results from VRAP are transmitted to volunteers following the conclusion of the sampling season, and are also retained for use in the 305(b) report/303(d) list.

Modifications to Approved QAPP

EPA New England requires that all modifications to an approved QAPP be documented and submitted for approval in the same manner as the original QAPP. The following paragraphs document the procedures that will be followed when any project activity originally documented in this QAPP requires real-time modification to achieve project goals.

Modifications to the VRAP QAPP will be documented and reported to EPA New England according to the following procedures. Each year, the QAPP is reviewed, and changes documented in a memorandum to the DES QA Manager (Vince Perelli).

1. *Sampling/Monitoring Program Design:* Each year, the Program Manager consults VRAP volunteers to discuss the need for modifications to the design. If modifications are necessary, the Program Manager revises the original QAPP and submits the revisions to the DES QA Manager.
2. *Sample Collection Procedures:* The Program Manager consults other NHDES staff to discuss the need for modifications to the procedures. If modifications are necessary, the Program Manager revises the original QAPP and submits the revisions to the DES QA Manager.
3. *Sample Analysis Procedures:* The Program Manager consults the Laboratory QA Officer to discuss the need for modifications to the procedures. If modifications are necessary, the Program Manager revises the original QAPP and submits the revisions to the EPA New England.
4. *Data Assessment and Reporting:* Each year, the Program Manager consults the Water Quality Planning/Reporting Supervisor to discuss the need for modifications to the annual VRAP reports and assessment approach. If modifications are necessary, the Program Manager revises the original QAPP and submits the revisions to the DES QA Manager.

4.3 Personnel Responsibilities and Qualifications

Several individuals are involved with the VRAP. Table 2 identifies project personnel and corresponding responsibilities.

4.4 Special Training Requirements/Certification

Training is required for water quality data collection, analysis, and data entry. The requirements are itemized in Table 3. The Program Manager maintains a spreadsheet that includes names of trained volunteers and the date of training for each calendar year (i.e., 2003, 2004, etc). The spreadsheet is developed from the attendance rosters from the individual training sessions. This spreadsheet serves as a certification of training.

Table 2. Personnel Responsibilities and Qualifications.

Name and Affiliation	Responsibilities	Education and Experience Qualifications
Ted Walsh (Program Manager) NHDES Watershed Management Bureau	<ul style="list-style-type: none"> - Coordinates and participates in all activities of VRAP - Trains volunteer monitors on sample collection and equipment use - Oversees development of water quality reports for volunteer monitors - Maintains dialogue with volunteers 	On file at NHDES
Paul Piszczek (Program QA Officer) NHDES Watershed Management Bureau	<ul style="list-style-type: none"> - Prepares and maintains the VRAP QAPP - Trains volunteer monitors on sample collection and equipment use - Assists with VRAP development 	On file at NHDES
Rachel Rainey (Laboratory QA Officer) NHDES Laboratory Services	<ul style="list-style-type: none"> - Oversees laboratory QA/QC activities and identifies necessary corrective actions 	On file at NHDES
Intern	<ul style="list-style-type: none"> - Trains volunteer monitors - Conducts field audits of volunteer monitors - Inputs data to water quality database - Assists with preparation of water quality reports 	On file at NHDES [Undergraduate student or recent graduate with coursework background in science (e.g., biology, environmental studies, chemistry)]
Volunteer Monitors	<ul style="list-style-type: none"> - Collect water samples - Use electronic water quality instrumentation for water analysis - Document field data and field conditions 	Individuals of various ages and educational backgrounds

Based on EPA-NE Worksheet #6

Table 3. Special Personnel Training Requirements

Project function	Description of Training	Training Provided by	Training Provided to	Location of Training Records
Water Sampling	Field instrumentation procedures and water sample collection methods	Program Manager, Program QA Officer, & NHDES-WMB personnel	VRAP Intern and Volunteer Monitors	NHDES – Watershed Management Bureau Office
Data Entry	Computer software overview and data entry procedures	Program Manager or Program QA Officer	VRAP Intern	NHDES – Watershed Management Bureau Office
Water Sample Analysis	Laboratory analytical procedures	QA Officer, NHDES Laboratory Services Unit	Laboratory Technicians	NHDES – Laboratory Services Unit

5.0 Project Planning/Project Definition

This section documents the project planning, identifies the environmental problem, defines the environmental questions that need to be answered, and provides background information.

5.1 Project Planning Meetings

To date, the planning process for the summer 2003 sampling period of the VRAP consisted of several internal scoping meetings, held during the winter of 2003. Staff of the NHDES Watershed Management Bureau attended the meetings, including Ted Walsh, (Program Manager), Paul Piszczek (Program QA Officer), Gregg Comstock (Water Quality Planning/Reporting Supervisor), and Paul Currier (NHDES Watershed Management Bureau Administrator). The historical aspects of the program, current and future needs of the program, and general attributes of the upcoming sampling approach were discussed at the meetings.

The planning process also includes meetings with individual volunteer groups or volunteer monitors, which are conducted from March through May. The meetings are coordinated by the Program Manager to discuss field sampling and analysis plans (SAPs) for the upcoming sampling season.

5.2 Problem Definition/Site History and Background

The rivers and streams of the State of New Hampshire receive drainage from multiple land use watersheds, which create diverse surface water quality conditions throughout the state. These conditions have varying implications for the support of aquatic life and human activities, which are directly related to state surface water quality standards. Water quality conditions relative to surface water quality standards have been documented through various water quality monitoring efforts, and results have depicted a wide range of water quality conditions relative to physical, chemical, and biological parameters such as temperature, turbidity, dissolved oxygen, pH, metals, and bacteria. Water quality is spatially and temporally dynamic, and generally reflects land and water management practices.

VRAP was instituted in 1998 by DES to encourage citizen-based volunteerism, awareness, and appreciation of the rivers and streams throughout New Hampshire. Initially, it was anticipated that the VRAP would offset the limitations of existing statewide monitoring (i.e., Ambient River Monitoring Program), where volunteers could be satisfactorily trained by DES to collect water quality data. This would consequently promote public education and outreach. The initiative for VRAP was based on the interest and success of the Volunteer Lake Assessment Program (VLAP), which focused on supporting citizen-based volunteerism regarding the water quality of inland lakes and ponds.

The volunteers currently involved with the VRAP possess a genuine interest in understanding the quality of the rivers and streams throughout New Hampshire, particularly in the context of New Hampshire surface water quality standards and designated uses. The program is ongoing, and continues to offer active water quality monitoring programs, person-to-person dialogue, and outreach events throughout the year. Volunteer monitors measure the physicochemical attributes of water quality, which provides a simplistic, quantitative approach to understanding water quality. This is based on the State's use of physicochemical parameters as the foundation of surface water quality standards and designated uses. VRAP volunteers collect most water quality samples under near-limiting ambient conditions (e.g., low stream flow, warm water temperatures) that typically occur during the summer months, although sampling occasionally continues during winter months. Monitoring is conducted by volunteers representing numerous volunteer "groups", and involves water sampling at existing VRAP locations. These stations generally represent areas of interest by volunteers.

6.0 Project Description and Schedule

This section presents a general overview of the activities that will be performed during this project and a schedule for implementation.

6.1 Project Overview

The water quality monitoring component of VRAP is designed to provide an opportunity for volunteers to better understand the water quality of rivers and streams throughout the state. Individual volunteer groups typically develop individual SAPs, based on volunteer group interest. Although SAPs are tailored to individual needs, the SAPs typically include similar target water quality parameters (e.g., dissolved oxygen, pH, etc.).

The primary objective of the individual volunteer monitoring programs is to determine whether NH surface water quality standards are met relative to the support of designated uses such as swimming and aquatic life. The water quality monitoring component of VRAP includes several sub-components: (1) planning and design; (2) field data collection; (3) laboratory analysis; and (4) data synthesis. The work products generated under VRAP include a summary report, distributed to the volunteers relative to surface water quality standards, and a water quality data set that is incorporated into the New Hampshire 303(d) list and 305(b) report for New Hampshire. Volunteers are typically instructed to collect data on an ongoing basis, which guides future monitoring efforts and supports impairment status decisions.

Planning and design tasks:

Multiple tasks relative to planning and design are accomplished prior to the onset of water quality monitoring, typically during the spring of each year. The number of potential volunteers and associated groups are enumerated by the Program Manager, which allows for the development of training and equipment loan schedules. In addition, the individual water quality monitoring programs are designed relative to the needs/interests of volunteers, which requires the coordination of annual meetings by the Program Manager. The implementation of the individual water quality monitoring programs is contingent on the functionality of field equipment. The Program Manager or QA Officer discerns the need for equipment repairs through the implementation of equipment testing procedures.

Field data collection tasks:

Several analytical parameters are included in VRAP (Table 4), and their use in the program is justified relative to the specific uses of a waterway. For example, elevated levels of *Escherichia coli* bacteria present a public health concern when a particular waterbody is used for swimming and/or bathing. Depressed dissolved oxygen and pH, high/low temperature, elevated turbidity levels may reduce the capability of a waterway to support aquatic life such as fish and benthic macroinvertebrate communities.

VRAP owns a fixed number of sampling “kits”, which contain specific water quality monitoring equipment (Table 4). The kits are loaned to the volunteer groups on an as-needed basis. In some cases, volunteer groups choose to purchase their own equipment with specifications consistent with the equipment in the kits or with the requirements documented in this QAPP.

Water samples are collected during the summer months under low flow, warm temperature conditions, as these conditions are assumed to represent the limiting conditions of most rivers and streams during the year. In addition, rivers and streams receive greatest recreational use during this period. Sampling stations are generally selected relative to the proximity to potential pollution sources (e.g., agricultural areas, point source outfalls, etc.). The number of samples collected is typically based on the interest and availability of volunteer monitors, although guidance from the VRAP Program Manager may be given, if requested. Sampling methods include the use of field instrumentation and glass/plastic sample storage

bottles; storage bottles are appropriately labeled with station name, date and time of sample collection, parameter of interest, and initials of volunteer monitors. All samples are collected during the morning and early afternoon hours, with all sampling information documented on field data sheets at the time of sampling.

For tables based on EPA-NE Worksheets #9b and #9c, please see Sections 7.0 and 8.0, respectively.

Analysis tasks: The primary water quality parameters under VRAP include dissolved oxygen, temperature, pH, specific conductance, and turbidity, which are measured in the field by the volunteer monitors. On occasion, volunteer monitors may collect water samples for laboratory analyses, such as nutrients, metals, and bacteria (Table 4). Depending on the requested analysis, volunteers transport samples to various laboratories, including those at wastewater treatment facilities, or the State of New Hampshire, Department of Environmental Services Laboratory Services Unit. Specific analytical services by NHDES are described in Table 4, and corresponding standard operating procedures (SOPs) for the analyses are given in Appendix A. Analytical services of other laboratories used by volunteer monitors are documented in annual SAPs developed by the individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office. A SAP template is provided in Appendix B.

Table 4. Surface water analytical services table

Analyte	Laboratory contact or instrument and person responsible
FIELD ANALYSIS (Water quality kits, except multiprobe)	
Water Temperature	Water Temperature: <i>YSI Model 95</i>
Dissolved oxygen	Dissolved Oxygen: <i>YSI Model 95</i>
pH	pH: <i>Orion Model 210A Meter and Triode Model 91-57BN Electrode</i>
Specific Conductance	Specific Conductance: <i>YSI Model 30</i>
Turbidity	Turbidity: <i>LaMotte Model 2020</i>
All field parameters	Multiprobe: <i>Hydrolab DataSonde 4a</i> Ted Walsh, 603-271-2083
LABORATORY ANALYSIS	
TP	NHDES Chemistry Laboratory 6 Hazen Drive, Concord, NH 03304 Rachel Rainey, 603-271-2993
NO ₃ +NO ₂	
TKN	
NH ₃	
Hardness	
Alkalinity	
TS	
TSS	
BOD ₅	
<i>E. coli</i>	
Aluminum	
Copper	
Lead	
Zinc	
Chlorophyll <i>a</i>	NHDES Limnology Laboratory 6 Hazen Drive, Concord, NH 03304 Jody Connor, 603-271-3414

Based on EPA-NE Worksheet #9d

Quality control tasks: Field water quality instrumentation and laboratory analytical instrumentation are calibrated according to manufacturer's specifications prior to all field measurements and laboratory analysis. Sample bottles are appropriately prepared (e.g., rinsed, sterilized, etc.) prior to sample

collection. Duplicate samples are analyzed at a frequency of 10% or more for field measurements. A complete description of quality control tasks is included in Section 13.0.

Secondary data: Water quality data collected under the NHDES Ambient River Monitoring Program (ARMP), which has an EPA-approved QAPP, may serve as secondary data in VRAP. For example, if data from the ARMP show potential water quality problems at particular sampling locations, or if water quality remediation measures were taken at a particular sampling station, the VRAP Program Manager may recommend water quality data collection at those stations.

Data management tasks: Field data and laboratory results are transmitted to the VRAP Program Manager for input to the water quality database. All entered data are checked against the field data sheets and laboratory bench book to ensure accuracy. The database serves as a clearinghouse for the development of volunteer reports, miscellaneous public inquiries, and NH surface water quality assessments.

Documentation and records: Field data are recorded on field data sheets, whereas laboratory data are recorded in laboratory bench books. Laboratory data are subsequently transferred to results sheets and transmitted to the VRAP Program Manager. Most original field data sheets completed by volunteer monitors are transmitted to the VRAP office, and retained by the VRAP Program Manager in a three-ring binder or filing cabinet. Occasionally, volunteer monitors retain the original field data sheets and transmit copies of the data sheets to the VRAP Program Manager. Regardless of whether originals or copies of field data sheets are transmitted to the VRAP Program Manager, all data contained on the data sheets are entered into the NHDES water quality database.

In addition to the field data sheet, several other documents are used in VRAP: (1) station description form for new stations only, which is completed prior to the start of the sampling period, (2) field equipment checklist, which provides guidance on necessary field equipment prior to most field sampling trips, and (3) field equipment maintenance log. A complete description of documentation and records are included in Section 15.0.

Data packages: Two types of data packages are created by VRAP: (1) Annual reports which describe the data in tabular and graphical format, specifically in the context of NH surface water quality standards, and (2) data tables, created upon request from volunteer monitors or the public. All data packages are created from post-processed data (i.e., after application of QA/QC guidelines).

Assessment/Audit tasks: VRAP assessments and audits are conducted throughout the year according to Chapter 9 of the most current version of the NHDES Quality Management Plan (QMP). A QA/QC report is prepared at the end of each calendar year.

Data verification and validation tasks: Data are verified by referencing replicate samples, reviewing critical ranges, reviewing consistency of spiked samples, and reviewing duplicate samples. The data are screened for outliers, with outliers being highlighted and examined to determine the origin of the deviation. Data are also compared with existing and historical data from individual sampling locations. A complete description of data verification and validation tasks and procedures are included in Sections 18.0 and 19.0.

Data usability tasks: Data usability is dependent on the objective of individual volunteer groups or monitors. For example, data are only usable for NH surface water quality assessments if collected according to appropriate SOPs and QA/QC guidelines. However, data not collected according to requisite procedures may be used to provide volunteer monitors and the public a general understanding of water quality (e.g., describe various parameters used for water testing). Section 20.0 includes a complete description of data usability assessments.

6.2 Project Schedule

VRAP consists of several activities that are completed throughout the year (Table 5). The due date of each deliverable is directly related to the amount of effort necessary to complete each activity, including the occurrences of delays. The Program Manager notifies VRAP participants of any delays associated with each activity. For example, equipment is typically loaned to volunteers from May through September. However, staff and financial resource constraints during any particular year may delay equipment distribution.

Table 5. Project Schedule Timeline

Activity	Dates (MM/DD/) ^a For Annual Activities		Deliverable	Deliverable Due Date
	Anticipated Date(s) of Initiation	Anticipated Date(s) of Completion		
Plan Volunteer River Assessment Program	December 1 of previous calendar year	May 31	--	--
Revise QAPP and SOPs, as necessary	March 1	May 31	QAPP Document and SOPs	May 31
Inventory supplies and equipment	February 1	March 31	Supply/equipment list	April 15
Test water quality equipment	February 1	April 30	Equipment tested	May 1
Conduct training sessions for volunteer monitors and distribute water quality sampling equipment	May 1	July 15	Training sessions	July 15
Receive and review water quality data	May 15	December 31	Water quality data	December 31
Input data to water quality database	June 1	December 31	Data input	December 31
Conduct field TSAs	June 1	September 30	Completed TSAs	September 30
Receive water quality sampling equipment	October 1	December 31	Equipment received	December 31
Synthesize data and create water quality reports	August 1	December 31	Water quality reports	December 31
Perform annual VRAP audit	September 1	December 31	Program audit memorandum	December 31

Based on EPA-NE Worksheet #10

^aYear is not specified, since VRAP is ongoing from year to year.

Activities related to data verification and synthesis succeeds the data collection phase. Any delays associated with data verification and synthesis (e.g., laboratory and/or computer complications) are reported to the Program Manager. The Program Manager subsequently reports delays to the volunteer monitors, and the schedule for water quality report distribution is revised accordingly.

VRAP typically initiates data collection during the first week of June of each calendar year. The end product of the program for each specific year is an individual water quality report for each volunteer group based on data collected by the group. The data set used to develop the reports is also used to support the development of the biennial NH 305(b) report and 303(d) list. The data set is delivered on or before December 31 of every year.

7.0 Project Quality Objectives and Measurement Performance Criteria

This section documents the environmental decisions that need to be made and the level of data quality needed to ensure that the decisions are based on sound data.

7.1 Project Quality Objectives

Data collected under VRAP serve (1) to augment the development of the NH 303(d) list and 305(b) report, provided that the data are collected in accordance with the SOPs provided in this QAPP, (2) as a basis for educating volunteers about the details of water quality, primarily through the development and distribution of annual water quality reports based on the data collected by volunteer monitors, and (3) to increase the amount of data available to the general public. The 303(d) list shows all rivers and streams whose status is considered impaired and in need of a total maximum daily load (TMDL) analysis, whereas the 305(b) report provides information on the overall quality of New Hampshire surface waters. Thus, the physical, chemical, and bacteriological characteristics of New Hampshire surface waters are depicted using numerous parameters, including temperature, turbidity, dissolved oxygen, pH, *Escherichia coli*, metals, and nutrients. These parameters are used to determine whether rivers and streams in New Hampshire meet legislative surface water quality standards, and support designated uses and aquatic life.

The use of VRAP data, as described above, inherently requires accurate data collection and documentation. Data are collected during summer months, when rivers and streams typically experience near-limiting ambient conditions (e.g., low stream flow, warm water temperatures). Rivers and streams included in VRAP generally represent waterways of interest to particular volunteer monitors. Many of these rivers and streams may depict general water quality characteristics throughout the state.

Volunteer monitors are trained by personnel of the Water Quality Planning Section of the DES Watershed Management Bureau to collect data using calibrated field water quality instrumentation and to collect water samples for laboratory analysis. Personnel from the NHDES Laboratory Services Unit analyze and report laboratory data. Validated data are compared with state surface water quality standards to determine whether standards are met. All field and laboratory methods are documented in Appendix A.

7.2 Measurement Performance Criteria

Several performance criteria are included to augment the quality of data collected and reported by VRAP. These criteria are listed in Table 6, and are briefly described below. **These descriptions are specific to analyses conducted by the DES laboratory.** However, volunteer monitors are not restricted to use the DES laboratory for any/all analyses; volunteers may select another laboratory, based on location, cost, or other factors. Measurement performance criteria for other laboratories are documented in annual SAPs developed by the individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office.

7.2.1 Precision

Precision is calculated for field and laboratory measurements through sample duplicates (environmental variability) and measurement replicates (instrumental variability), and is calculated for each sampling day. For field and laboratory duplicates, data retention for water quality assessment purposes is contingent on compliance with a parameter-specific (Table 6) relative percent difference (RPD) as derived from equation 1, below. Table 6 shows typical parameters studied under VRAP.

(1)

$$RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100 \%$$

where x_1 is the original sample concentration
 x_2 is the duplicate sample concentration

Precision calculations in the laboratory are derived from duplicate sample analysis, where duplicate sample frequency varies according to analyte (e.g., one duplicate for every eight total phosphorus samples) (Table 20 through Table 34, Section 13.2.2). Precision is expressed as ranges (i.e., calculation of difference between actual sample and duplicate sample).

Table 6. Measurement Performance Criteria for Surface Water Samples

Analytical Parameter	SOP Reference	Measurement Performance Criteria			QC Sample and/or Activity Used to Assess Measurement Performance
		Precision	Accuracy	Sensitivity	
Temperature	A-1	RPD $\leq 5\%^a$			Field duplicates
		RPD $\leq 5\%^a$			Measurement replicates
Dissolved Oxygen	A-1	RPD $\leq 5\%^a$			Field duplicates
		RPD $\leq 5\%^a$			Measurement replicates
			$\pm 2.0\%$ of saturation ^b		Meter review ^c
pH	A-1	RPD ≤ 0.2 std units ^a			Field duplicates
		RPD ≤ 0.2 std units ^a			Measurement replicates
			± 0.2 standard units		Known buffer (pH = 6.0)
Specific Conductance	A-1	RPD $\leq 5\%^a$			Field duplicates
		RPD $\leq 5\%^a$			Measurement replicates
Turbidity	A-1	RPD $\leq 5\%^a$			Measurement replicates
			± 1.0 NTU		Field blank
Total phosphorus	A-3	RPD $\leq 30\%$			Field duplicates
		Range ^d 0-0.009 mg/l		MDL =0.0031 mg/l	Lab duplicates
			$r^2 \geq 0.995$		Initial calibration
			$\pm 10\%$ of 0.1 mg/l		ICV ^d
			86-117%		LFM recovery
				$< \frac{1}{2}$ PQL	Annual calculation of MDL
NO ₃ +NO ₂	A-4	RPD $\leq 15\%$			Field duplicates
		Range 0.00-0.03 mg/l		MDL =0.017 mg/l	Lab duplicates
			$r^2 \geq 0.995$		Initial calibration
			$\pm 10\%$ of 2.5 mg/l		ICV
			90-110%		LFM recovery
				$< 1/10$ PQL	Annual calculation of MDL
TKN	A-5	RPD $\leq 15\%$			Field duplicates
		Range 0.00-0.33 mg/l		MDL=0.10 mg/l	Lab duplicates
			$r^2 \geq 0.995$		Initial calibration
			$\pm 10\%$ of 3.5 mg/l		ICV
			78-123%		LFM recovery
				1 PQL	Annual calculation of MDL

Analytical Parameter	SOP Reference	Measurement Performance Criteria			QC Sample and/or Activity Used to Assess Measurement Performance
		Precision	Accuracy	Sensitivity	
NH ₃	A-6	RPD \leq 15%			Field duplicates
		Range 0.00-0.32 mg/l		MDL dig=0.1	Lab duplicates
			$r^2 \geq 0.995$		Initial calibration
			$\pm 10\%$ of 8.22 mg/l	MDL undig=0.04	ICV
			84-110%		LFM recovery
				<1/6 PQL	Annual calculation of MDL
Hardness	A-7	RPD \leq 15%			Field duplicates
		Range 0.00-2.26 mg/l			Lab duplicates
			$\pm 10\%$ of 38.2 mg/l	MDL =0.096 mg/l	ICV
			88-111%		LFM recovery
				<1/10 PQL	Annual calculation of MDL
Alkalinity	A-8	RPD \leq 15%			Field duplicates
		Range 0.00-0.44 mg/l		MDL=0.2 mg/l	Lab duplicates
			$\pm 10\%$ of 50 mg/l		ICV
				<1/4 PQL	Annual calculation of MDL
Total Solids	A-9	RPD \leq 20%			Field duplicates
		RPD 20%			Lab duplicates
			$\pm 10\%$ or vendor limits	RDL<1	Laboratory control sample
Total Suspended Solids	A-10	RPD \leq 20%			Field duplicates
		RPD 20%			Lab duplicates
			$\pm 10\%$ or vendor limits	RDL<1	Laboratory control sample
BOD ₅	A-11	RPD \leq 15%			Field duplicates
		Range 0.00-0.86 mg/l		RDL <2, <3 on a 1.5x dilution	Lab duplicates
			77-136%		LFM recovery
			$\pm 10\%$ of 3.4 mg/l		Laboratory control sample
<i>E. coli</i>	A-12	RPD \leq 50% if maximum of either of two samples < 406 cts/100 ml; RPD \leq 20% if maximum of either of two samples \geq 406 cts/100 ml			Field duplicates
			0 counts/100 ml		Lab blanks
Aluminum	A-7	RPD \leq 15%			Field duplicates
		Range 0.000-0.024 mg/l			Lab duplicates
			$\pm 10\%$ of 2 mg/l	Al MDL= 0.014 mg/l	ICV

Analytical Parameter	SOP Reference	Measurement Performance Criteria			QC Sample and/or Activity Used to Assess Measurement Performance
		Precision	Accuracy	Sensitivity	
Copper	A-13		91-106%		LFM recovery
				<1/3 PQL	Annual calculation of MDL
		RPD \leq 15%			Field duplicates
		Range 0-0.019 mg/l			Lab duplicates
				10% of 0.020	ICV
Lead	A-13		Cu 85-110%		LFM recovery
				<1/10 PQL Cu MDL= 0.081 ug/L	Annual calculation of MDL
		RPD \leq 15%			Field duplicates
		Range 0.0000-0.003 mg/l			Lab duplicates
			\pm 10% of 0.02 mg/l	Pb MDL= 0.042 ug/L	Pb ICV
Zinc	A-13		85-115%		Pb LFM recovery
				<1/10 PQL	Annual calculation of MDL
		RPD \leq 15%			Field duplicates
		Range 0.000-0.009 mg/l		Zn MDL= 0.056 ug/L	Lab duplicates
			\pm 10% of 0.02 mg/l		ICV
Chlorophyll <i>a</i>	A-14		79-103%		LFM recovery
		RPD \leq 15%			Field duplicate
			N/A-Back correction only		Instrument blank

^abased on data collected under VRAP and the DES Ambient River Monitoring Program during previous years

^bRelative accuracy

^cmeter review = reading taken with sensor in storage chamber immediately following calibration; early detection of drift

^drange is difference between original sample and laboratory duplicate

^eICV = Initial calibration verification

7.2.2 Accuracy

Accuracy for field measurements is determined for all field parameters except temperature (Table 6). Field blanks are measured for specific conductance and turbidity, whereas a known buffer is used to determine the accuracy of the pH meter. Temperature sensors do not require accuracy determinations, as the sensors are tested in the laboratory prior to the commencement of the monitoring period.

Accuracy limits of laboratory analyses are defined through independent calibration verifications and continuing calibration verifications of laboratory control samples (Table 20 through Table 34). Spiked samples are used to determine matrix interference. Complete definitions of accuracy are provided in the SOPs for individual parameters (Appendix A).

7.2.3 Representativeness

VRAP supports volunteer water quality monitoring programs to augment DES statewide water quality monitoring for the determination of whether rivers and streams in New Hampshire attain surface water quality standards and support legislative designated uses. Many water quality parameters are spatially and temporally dynamic, and experience near-limiting ambient conditions (e.g., low stream flow,

warm water temperature) typically during the summer. For example, dissolved oxygen concentrations are typically least during the early morning hours in response to photosynthetic/respiration cycles. It is assumed any waterway attaining the state surface water quality standards for dissolved oxygen during the early morning hours will attain standards throughout other times of the day, although this is not true in every case. Based on this assumption, water samples are collected between the hours of 05:30 a.m. and 5:30 p.m. during June, July, August, and early September. Spatial dynamics relate to many attributes, including land use, geology, and the river channel. Therefore, sampling locations are established in agricultural, urban, and forest areas with variable channel characteristics throughout the state.

Volunteers are encouraged to collect water samples during periods of dry and wet weather, depending on the water quality parameter of interest. Dry weather periods are defined as periods of no rain at least three days prior to sample collection.

7.2.4 Comparability

VRAP employs field and laboratory instrumentation and methodology that are consistent among sampling locations, which allows for comparison of data among stations and multiple years. Although field measurements are made at each site on different days throughout the summer, measurements are made during the same general time frame during the day (i.e., between 5:30 a.m. and 5:30 p.m.). However, dissolved oxygen data are only compared to dissolved oxygen data collected during the same time of day (i.e., between 7:00 a.m. and 9:00 a.m.), since dissolved oxygen levels are typically greater during the mid-afternoon hours in many rivers and streams. This is consistent with procedures used during previous monitoring activities.

Water samples are collected and transported to the NHDES Laboratory Services Unit or other laboratory during similar times of day. This is consistent with procedures used during previous monitoring activities.

7.2.4 Sensitivity

VRAP is designed to support volunteer water quality monitoring programs relative to the state surface water quality standards and legislative designated uses. Therefore, the field and laboratory instrumentation used in the program are capable of analyzing water samples that do not attain water quality standards. Specific detection limits are provided in Table 7.

7.2.5 Quantitation Limits

The analytical method, analytical/achievable method detection limit, and the analytical/achievable laboratory quantitation limits for samples collected under VRAP and analyzed by the NHDES Laboratory Services Unit are shown in Table 7. To date, quantitation limits have not been defined for chlorophyll *a*, and are not provided in Table 7. Upon definition of the quantitation limits for chlorophyll *a*, NHDES will transmit a letter to EPA-NE for the purposes of updating Table 7 of this QAPP. A copy of the letter will also be transmitted to the NHDES Quality Assurance Manager. Quantitation information for other laboratories used by volunteer groups is documented in annual SAPs developed by the volunteer groups.

Table 7. Surface Water Target Analytes and Reference Limits (MDL and RDL Data)

Analyte	Analytical method (See Appendix A for SOPs)	Analytical/Achievable Method Detection Limit	Analytical/Achievable Laboratory Quantitation Limit
Field Measurement			
Temperature	YSI Model 95	--	--
Dissolved oxygen	YSI Model 95	0.1 mg/L; 0.1%	--

Analyte	Analytical method (See Appendix A for SOPs)	Analytical/Achievable Method Detection Limit	Analytical/Achievable Laboratory Quantitation Limit
		saturation	
pH	Orion Model 210A Meter and Triode Model 91-57BN Electrode	--	--
Specific Conductance	YSI Model 30	0.6 µS/cm	--
Turbidity	Lamotte Model 2020	0.01 NTU	--
Temperature	Hydrolab DataSonde 4a	--	--
Dissolved oxygen	Hydrolab DataSonde 4a	0.2 mg/L; 0.2% saturation	--
pH	Hydrolab DataSonde 4a	--	--
Specific Conductance	Hydrolab DataSonde 4a	0.6 µS/cm	--
Turbidity	Hydrolab DataSonde 4a	0.01 NTU	--
Laboratory Analysis			
Total phosphorus	EPA 365.2; Lachat QuikChem Method 10-115- 01-1-F	0.003 mg/L	0.005 mg/l
NO ₃ +NO ₂	EPA-600/R-93-100, Method 353.2; Lachat 10-107-04-1-A	0.017 mg/L	0.05 mg/l
TKN	EPA-600/4-79-020, Method 351.2; Lachat Method #10- 107-06-2-E	0.10 mg/L	0.25 ^a mg/l
NH ₃	Standard Method 4500-NH3- B (APHA, 1995); 1.Lachat Method #10-107-06-1-A	undigested 0.014 mg/L	0.25 ^a mg/l
Hardness	EPA 200.7	0.096 mg/l	2.9 mg/l
Alkalinity	EPA 600/4-79-020, Method 310.1; Standard Method 2320 B (APHA, 1995)	0.2 mg/l	5 mg/l
Total Solids	EPA 600/4-79-020, Method 160.3; Standard Method 2540 B (APHA, 1995)	N/A	1 ^a mg
Total Suspended Solids	EPA 600/4-79-020, Method 160.2; Standard Method 2540 D (APHA, 1995)	N/A	1 ^a mg
BOD ₅	EPA 600/4-79-020, Method 360.1; Standard Method 5210 B (APHA, 1995)	N/A	<3 ^a mg/l on a 1.5x dilution
<i>E. coli</i>	Membrane Filter Procedure, EPA 600/4-85/076; Standard Method 9213D.3 (APHA, 1995)	0+ cts/100 mL (depends on dilution and sample volume)	0+ cts/100 mL (depends on dilution and sample volume)
Aluminum	EPA 200.7	0.0141 mg/l	0.05 mg/l
Copper	EPA 200.8	0.081 µg/l	5 ^a µg/l
Lead	EPA 200.8	0.042 µg/l	1 µg/l
Zinc	EPA 200.8	0.056 µg/l	5 µg/l
Chlorophyll <i>a</i>	Standard Methods (1998) Method 10200H	TBD ^b	TBD

Based on EPA-NE Worksheet #9b

^aLower limits may be achieved from year to year, subject to agreement with NHDES Laboratory Services

^bTo be determined – in consultation with EPA-NE

7.2.6 Completeness.

Data collected under VRAP is voluntary. Although the data are used to augment the NHDES water quality database, any amount of data collected by volunteers is acceptable to NHDES. Completeness typically exceeds 75% for any given monitoring year.

8.0 Sampling Process Design (Experimental Design)

This section describes the sampling rationale and procedures.

8.1 Sampling Design Rationale

VRAP supports diverse water quality monitoring programs to satisfy the needs of individual volunteer groups. Since water quality monitoring under VRAP is completely voluntary, a concrete sampling design need not be established. The monitoring programs often have spatial and temporal limitations, which are not considered prohibitive for volunteer monitoring. For example, in many cases, volunteer groups are concerned about the impacts of land and water management practices. Therefore, the groups choose to establish sampling stations relative to a particular area of concern (e.g., landfill, wastewater treatment facility). In other cases, volunteer groups prefer to examine the background or general conditions of local rivers and streams. The temporal limitations are a result of volunteer and equipment availability. In many cases, volunteer groups are available to sample every other week throughout the summer months. In other cases, volunteers are available to sample monthly throughout the year. VRAP encourages volunteers to sample on a biweekly basis during the summer months.

Sampling designs are developed by the individual volunteer groups, and may differ from year to year depending on the concerns/needs of the volunteers (Table 8). The rationale for sampling, and specific sampling information (e.g., analytes, number of samples, etc.) are documented in annual SAPs developed by the individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office.

NHDES uses a Consolidated Assessment and Listing Methodology (CALM) to facilitate the development of 303(d) lists and 305(b) reports for the State of New Hampshire. These documents are supported by data collected under VRAP. Thus, if requested by individual volunteer groups, NHDES provides sampling design guidance relative to statewide surface water quality assessments.

Table 8. Surface Water Field Sample Summary

Analyte	Sample Type	Number of sampling stations	Sampling Frequency	Number of field duplicates	Total Number of samples to lab
Variable year to year, including, but not limited to <ul style="list-style-type: none"> • Temperature • Dissolved oxygen • pH • Specific Conductance • Turbidity • Total Phosphorus • Nitrate+nitrite (NO₃+NO₂) • TKN • Ammonia • Hardness • Alkalinity • Total Solids • Total Suspended Solids • BOD₅ • <i>E. coli</i> • Aluminum • Copper • Lead • Zinc • Chlorophyll <i>a</i> 	Surface Grab	Variable year to year; typical range: 5-25	Variable year to year; typically biweekly during June, July, August	Variable, based on sampling frequency	Variable, based on sampling frequency
<ul style="list-style-type: none"> • Temperature • Dissolved oxygen • pH • Specific conductance • Turbidity 	In-situ measurement (continuous)	Variable year to year	Variable year to year; typically once or twice during summer for a 5-7-day period	none	none

Based on EPA-NE Worksheet #9c

9.0 Sampling Procedures and Requirements

This section describes in detail how samples will be collected. Use of field analytical equipment is discussed in Section 11.0.

9.1 Sampling Procedures

VRAP employs a routine, standardized approach to collecting water quality data. This approach increases consistency among samplers, facilitates the collection of accurate and precise data, increases the representativeness of samples, and augments data comparability.

All sampling activities, including field measurements and water sample collection, are conducted between 5:30 a.m. and 5:30 p.m., Monday through Sunday, typically on a biweekly basis. All field measurements and samples collected for laboratory analyses are collected using a sampling bucket noted in the SOP in Appendix A. The bucket is filled to at least one-half of its capacity, which ensures sufficient volume for all field measurements and sample storage containers. Samples for laboratory analysis are immediately transferred to individual sample storage containers (i.e., polyethylene or glass bottles), appropriately preserved, and stored on ice prior to the measurement of field parameters (Table 9). The requirements shown in Table 9 are specific to samples analyzed by the NHDES Laboratory Services Unit. Requirements for other laboratories are documented in annual SAPs developed by the volunteer groups. Sample collection, preservation, and storage procedures are followed according to the SOP in Appendix A. Field measurements are subsequently recorded from the water collected in the bucket for temperature, dissolved oxygen, pH, turbidity, and specific conductance (Table 10). Any comments relevant to the sampling event (e.g., sampling and/or instrumentation problems) are documented on field data sheets prior to traveling to the next sampling location. This procedure is repeated at all scheduled sampling locations for a particular day. All water samples are transported to the laboratory after the conclusion of sampling at the final site.

Table 9. Sample preservation and holding time requirements

Analytical parameter	Collection method	Preservation SOP (Appendix)	Sample volume	Container size and type	Preservation requirements	Max. holding time (preparation and analysis)
Temperature	in-situ measurement	A-15	NA	NA	NA	NA
Dissolved oxygen	in-situ measurement	A-15	NA	NA	NA	NA
pH	in-situ measurement	A-15	NA	NA	NA	NA
Specific Conductance	in-situ measurement	A-15	NA	NA	NA	NA
Turbidity	in-situ measurement	A-15	15 ml	15 ml, clear glass	NA	NA
Temperature	in-situ measurement (continuous)	A-15	NA	NA	NA	NA
Dissolved oxygen	in-situ measurement (continuous)	A-15	NA	NA	NA	NA
pH	in-situ measurement (continuous)	A-15	NA	NA	NA	NA
Specific Conductance	in-situ measurement	A-15	NA	NA	NA	NA

Analytical parameter	Collection method	Preservation SOP (Appendix)	Sample volume	Container size and type	Preservation requirements	Max. holding time (preparation and analysis)
	(continuous)					
Turbidity	in-situ measurement (continuous)	A-15	NA	NA	NA	NA
Total phosphorus	Surface Grab	A-15	250 ml	250 ml brown polyethylene	H ₂ SO ₄ to pH<2, light protected, chilled to 4°C	28 days
Nitrate+nitrite (NO ₃ +NO ₂)	Surface Grab	A-15	50 ml	500 ml white polyethylene	chilled to 4°C	48 hours
TKN	Surface Grab	A-15	250 ml	250 ml brown polyethylene	H ₂ SO ₄ to pH<2, chilled to 4°C	28 days
Ammonia	Surface Grab	A-15	250 ml	250 ml brown polyethylene	H ₂ SO ₄ to pH<2, chilled to 4°C	28 days
Hardness	Surface Grab	A-15	500 ml	500 ml LDPE or HDPE	HNO ₃ to pH<2, chilled to 4°C	6 months
Alkalinity	Surface Grab	A-15	100 ml	100 ml polyolefin or glass	chilled to 4°C	14 days
TS	Surface Grab	A-15	100 ml	100 ml polyethylene	chilled to 4°C	7 days
TSS	Surface Grab	A-15	100 ml	100 ml polyethylene	chilled to 4°C	7 days
BOD ₅	Surface Grab	A-15	500 ml	500 ml polyethylene or glass	chilled to 4°C	48 hours
<i>E. coli</i>	Surface Grab	A-15	100 ml	250 ml sterile white polyethylene	chilled to ≤ 10°C	8 hours ^a
Aluminum	Surface Grab	A-15	500 ml	500 ml LDPE or HDPE	HNO ₃ to pH<2, chilled to 4°C	6 months
Copper	Surface Grab	A-15	500 ml	500 ml LDPE or HDPE	HNO ₃ to pH<2, chilled to 4°C	6 months
Lead	Surface Grab	A-15	500 ml	500 ml LDPE or HDPE	HNO ₃ to pH<2, chilled to 4°C	6 months
Zinc	Surface Grab	A-15	500 ml	500 ml LDPE or HDPE	HNO ₃ to pH<2, chilled to 4°C	6 months
Chlorophyll <i>a</i> ^b	Surface Grab	A-15	500 ml	500 ml opaque polyethylene	Unfiltered, dark, 4°C	24 hours
					Filtered, dark -20°C	28 days

Based on EPA-NE Worksheet #12b

^aMaximum transport time is 6 hours; must begin analysis within 2 hours after receipt at laboratory

^btwo-step process, with filtration occurring within 24 hours and analysis within 28 days; frozen storage before analysis

Table 10. Project Sampling SOP Reference Table

SOP title, revision date and/or number	Reference number (Appendix)	Originating organization	Equipment used
<u>Sampling</u> : Volunteer River Assessment Program Water Quality Monitoring Standard Operating Procedures (SOP): May 2003	A-1	NHDES	Plastic sample storage containers; plastic bucket
<u>Washing</u> : Lab SOP for sample storage containers	A-15	NHDES	Plastic sample storage containers
<u>Cleaning</u> : Ambient River Monitoring Program Field Standard Operating Procedures (SOP): [Dissolved oxygen/Temperature; pH; Specific Conductance; Turbidity; Hydrolab DataSonde 4a and MiniSonde; Sampling] – May 2002 (or as revised, year to year)	A-16	YSI Incorporated, Orion Research, Inc., Lamotte Co.	Electronic meters
<u>Decontamination</u> : Ambient River Monitoring Program Field Standard Operating Procedures (SOP): [Dissolved oxygen/Temperature; pH; Specific Conductance; Turbidity; Hydrolab DataSonde 4a and MiniSonde; Sampling] – May 2002 (or as revised, year to year)	A-16	YSI Incorporated, Orion Research Inc., Lamotte Co.	Electronic meters

Based on EPA-NE Worksheet #13

9.2 Sampling SOP Modifications

Modifications to the sampling SOP during any particular sampling year are not necessary to meet the project quality objectives of VRAP. However, modifications may occur prior to the onset of sampling during any particular year, and is based on needs identified during the previous sampling year.

9.3 Cleaning and Decontamination of Equipment/Sample Containers

Cleaning and decontamination of field sampling equipment (e.g., sample storage containers) occurs in the laboratory prior to use, and are described in the SOP in Appendix A. Cleaning and decontamination of field analytical equipment is discussed in Section 11.

9.4 Field Equipment Calibration

VRAP uses minimal field equipment for water sampling tasks, whereas multiple instruments are used for analytical tasks. (See Section 11 for field equipment calibration information.) Sample storage containers, a sampling bucket, variable-length rope and cable, and padlocks are the only pieces of equipment related to sampling (Table 11). Calibration is not necessary for this equipment. Thus, calibration and acceptance criteria are not described.

Table 11. Field sampling equipment calibration table

Equipment name	Procedure and SOP Reference	Frequency of calibration	Acceptance criteria	Corrective action	Person responsible
Nutrient sample storage container	--	--	--	--	Laboratory QA Manager
Bacteria sample storage container	--	--	--	--	Laboratory QA Manager
Metals sample storage container	--	--	--	--	Laboratory QA Manager
Sampling bucket	--	--	--	--	Volunteer Monitors; VRAP Intern
Various lengths of rope and cable	--	--	--	--	Volunteer Monitors; VRAP Intern
Padlocks	--	--	--	--	Volunteer Monitors; VRAP Intern

Based on EPA-NE Worksheet #14

9.5 Field Equipment Maintenance, Testing and Inspection Requirements

VRAP uses minimal field equipment for water sampling, whereas multiple instruments are used for analytical tasks. Sample storage containers, a sampling bucket, variable-length rope and cables, and padlocks are the only pieces of equipment related to sampling (Table 12). An SOP for preparing sample bottles is given in Appendix A. Equipment maintenance logs are retained in the Water Quality Planning Section office in Concord.

9.6 Inspection and Acceptance Requirements for Supplies/Sample Containers

The Program Manager, VRAP intern, Laboratory QA Manager, and volunteer monitors examine the supplies and sample containers prior to use. Additional supplies and sample storage containers accompany the volunteer monitors during sample collection in the event that contamination or damage of another container occurs. The NHDES laboratory SOP for preparing sample bottles is given in Appendix A, whereas SOPs from other laboratories are documented in annual SAPs developed by individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office.

Table 12. Field Sampling Equipment Maintenance, Testing, and Inspection

Equipment name	Activity	Frequency of activity	Acceptance criteria	Corrective action	Person responsible
Nutrient, bacteria, metals sample storage containers	Maintenance (cleaning); Inspection	As necessary, prior to use	No visible internal contamination or external damage	If found contaminated or damaged prior to sampling, do not use. Use alternate sample container.	Rachel Rainey, Laboratory QA Manager
Sampling bucket	Maintenance (cleaning); Inspection	As necessary, prior to use	No visible internal contamination or external damage	If found contaminated or damaged prior to sampling, do not use. Use alternate bucket.	Volunteer Monitors, VRAP Intern
Various lengths of rope and cable	Maintenance; Inspection	As necessary, prior to use	No visible damage	If found damaged prior to sampling, do not use. Use alternate rope or cable.	Volunteer Monitors, VRAP Intern
Padlocks	Maintenance; Inspection	As necessary, prior to use	No visible damage	If found damaged prior to sampling, do not use. Use alternate padlock.	Volunteer Monitors, VRAP Intern

Based on EPA-NE Worksheet #15

10.0 Sample Handling, Tracking and Custody Requirements

10.1 Sample Collection Documentation

VRAP requires documentation of activities during data collection. All documentation is described in Sections 10.1.1 and 10.1.2, which ensures sample authenticity and data integrity.

10.1.1 Field Notes

The field data sheets are tabularized to include, but not limited to: Date, Time, Site ID, River Name, Weather, Dissolved Oxygen, Temperature, Specific Conductance, Turbidity, pH, and Comments. The water quality data and associated comments are retained in individual volunteer group file folders, and the data sheets are added to the files throughout the sampling season. Appendix C contains a sample field data sheet.

The file folders are also used to retain formatted station description forms for documenting the metadata associated with each sampling station, including, but not limited to station ID, water depth, stream width, latitude, and longitude.

10.1.2 Field Documentation Management System

Field documentation during each sampling year includes water quality data, comments regarding any problems with instrumentation/sampling, and physical attributes of each station. The water quality data and associated comments are retained in individual file folders. The folders also contain station description forms, which are retained indefinitely, and stored in the NHDES, Watershed Management Bureau, Water Quality Planning Section office in Concord, NH. Completed field data sheets are transmitted to the Program Manager approximately biweekly. The file folders are archived prior to the commencement of the following monitoring season, and retained indefinitely in the Water Quality Planning Section office.

10.2 Sample Handling and Tracking System

All water samples are identified and tracked through documentation on field data sheets (Appendix C).

10.2.1 Field Tasks

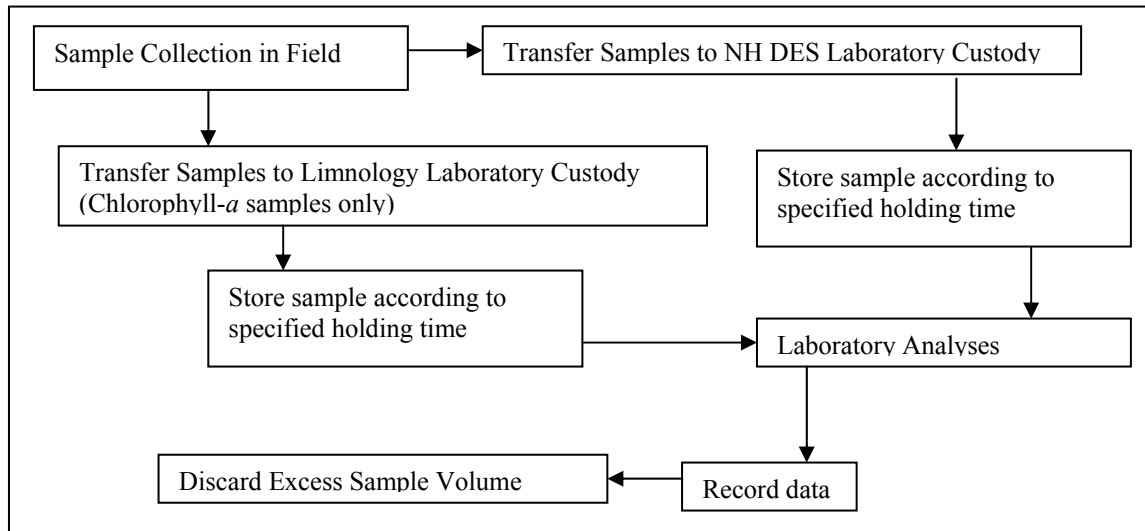
Prior to sample collection, all water sample storage containers are labeled with the following information: station identification number/name, date of sample collection, parameter of interest, preservation method (if any), initials of the volunteer monitor(s), and “duplicate”, “replicate”, “blank”, etc, as appropriate. Labeling prior to collection augments the legibility of the information, as condensation on the outside of a sample container generally occurs rapidly after water is placed in the container. However, the time of sample collection is written on the label immediately after the sample is collected.

10.2.2 Laboratory Tasks

This section describes tasks associated with samples analyzed by NHDES Laboratory Services Unit. Tasks associated with other laboratories are documented in annual SAPs developed by the individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office. The information recorded on the sampling container, as well as any other comments and/or notes, is transferred to a Login and Custody Sheet at the laboratory. This information is also transferred from the Login and Custody Sheet to the Laboratory Information Management System (LIMS) database, which provides a printed

label for each logged sample. The printed label contains all information written on the sample storage container, as well as the login date and time. Water samples are analyzed for parameters listed in Table 6, Section 7.2. Any excess sample water is discarded in laboratory sinks, unless otherwise specified in the SOP in Appendix A.

Figure 2. Typical Sampling Handling/Tracking/Custody Summary



10.3 Sample Custody

Water samples analyzed by the NHDES Laboratory Services Unit are collected in sample storage containers provided by the Laboratory Services Unit. Water samples analyzed by other laboratories are collected in sample storage containers provided by the specific laboratory; the information is documented in annual SAPs developed by the individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office. All samples are placed on cubed ice in a portable, opaque cooler immediately after collection, and transported to the laboratory. Samples not requiring preservative are transported within six hours after collection, whereas preserved samples are transported within eight hours after collection.

Upon arrival at the NHDES laboratory, the volunteer monitor is responsible for completing a Login and Custody Sheet supplied by the NHDES Laboratory Services Unit (Figure 2). The information recorded on the sampling container, as well as any other comments and/or notes, is transferred to the Login and Custody Sheet. Water samples are transferred from the cooler to a refrigerator at the laboratory after appropriate login procedures. However, samples for chlorophyll *a* are taken to the Limnology Center Laboratory down the hall from the NHDES Laboratory. Samples are subsequently logged into a database by Limnology Center Laboratory staff. See Table 9 for sample container, volume, preservation information, and holding time information. The volunteer monitor is divested from responsibilities after completing the Login and Custody Sheet.

Laboratory personnel are subsequently responsible for transferring information from the Login and Custody Sheet to the LIMS, which provides a printed label for each logged sample. The label contains all information written on the sample storage container, as well as the login date and time. Water samples are analyzed for parameters listed in Table 6, Section 7.2. The time of analysis is dependent on the holding time for the parameter of interest, where analyses are never conducted after the designated

holding time expires. Analytical data are subsequently entered into the laboratory database, and printed on laboratory letterhead. Printed results are transmitted to the Program Manager. Excess sample water is discarded in laboratory sinks, unless otherwise specified in the SOP in Appendix A.

11.0 Field Analytical Method Requirements

This section describes the analytical techniques used in the field to generate data for the ARMP. All field analytical methods, and SOPs used to meet measurement performance criteria and achieve project quantitation limits are documented in this section.

11.1 Field Analytical Methods and SOPs

The VRAP uses several water quality instruments for *in-situ* field measurements, and retrieves numerous water samples for various laboratory analyses (Table 13). Methods for all field activities (*in-situ* measurements and water sample collection) are documented as SOPs in Appendix A.

Table 13. Field Analytical Method/SOP Reference Table

Reference Number (Appendix)	Title, Revision date or number	Definitive (D) or screening (S) data	Analytical parameter	Instrument	Origin of SOP (Organization)	Organization performing field analysis
A-1	Volunteer River Assessment Program Water Quality Monitoring Standard Operating Procedures (SOP): May 2003	D	Water Temperature	Electronic meter	YSI Incorporated	Volunteers
		D	Dissolved Oxygen	Electronic meter	YSI Incorporated	Volunteers
		D	pH	Electronic meter	Orion Research, Inc.	Volunteers
		D	Specific Conductance	Electronic meter	YSI Incorporated	Volunteers
		D	Turbidity	Electronic meter	Lamotte Company	Volunteers
A-2	Ambient River Monitoring Program Field Standard Operating Procedures (SOP): Hydrolab DataSonde 4a and MiniSonde	D	Temperature, Dissolved Oxygen; pH; Specific Conductance; Turbidity	Electronic submersible multiprobe	Hydrolab Corporation	Volunteers

Based on EPA-NE Worksheet #20

11.2 Field Analytical Method/SOP Modifications

Modifications to the field analytical methods/SOPs during any particular sampling year are not necessary to meet the project quality objectives of VRAP. However, modifications may occur prior to the onset of sampling during any particular year, and is based on needs identified during the previous sampling year.

11.3 Field Analytical Instrument Calibration

All field instruments are calibrated prior to use according to manufacturer's specifications. Calibration methods for all instruments are summarized in Table 14 and documented in detail in Appendix A.

Table 14. Field analytical equipment calibration table

Equipment name	Procedure and SOP Reference (Appendix)	Frequency of calibration	Acceptance criteria	Corrective action	Person responsible
YSI Model 95: Dissolved oxygen and temperature	A-1	Prior to each measurement (i.e., if seven measurements are made during the day, the meter is calibrated prior to each of the seven measurements)	$\pm 2\%$ of saturation, relative to initial calibration saturation	Recalibrate. If problem persists, inspect/replace batteries, membrane, and electrolyte. Recalibrate.	Volunteer Monitors, Program Manager
Orion Model 210A Meter and Triode Model 91-57BN Electrode: pH	A-1	Prior to each measurement (i.e., if seven measurements are made during the day, the meter is calibrated prior to each of the seven measurements)	Slope value 92-102%	Recalibrate. If problem persists, inspect/replace batteries, replace buffers, ensure electrode is appropriately filled with filling solution. Recalibrate.	Volunteer Monitors, Program Manager
YSI Model 30: Specific Conductance	A-1	Daily, prior to use	$\pm 25 \mu\text{S}/\text{cm}$	Turn off. Inspect/replace batteries. Turn on.	Volunteer Monitors, Program Manager
LaMotte Model 2020: Turbidity	A-1	Prior to each measurement (i.e., if seven measurements are made during the day, the meter is calibrated prior to each of the seven measurements)	$\pm 0.5 \text{ NTU}$	Recalibrate. If problem persists, inspect/replace batteries and standard solutions. Recalibrate.	Volunteer Monitors, Program Manager
Hydrolab DataSonde 4a Dissolved Oxygen and Temperature	A-2	Prior to deployment	$\pm 0.2 \text{ mg/l}$	Recalibrate. If problem persists, replace membrane, and electrolyte. Recalibrate.	Program Manager, QA Officer
Hydrolab DataSonde 4a: pH	A-2	Prior to deployment	$\pm 0.2 \text{ std. units}$	Recalibrate. If problem persists, replace buffers, ensure electrode is appropriately filled with filling solution. Recalibrate.	Program Manager, QA Officer
Hydrolab DataSonde 4a: Specific Conductance	A-2	Prior to deployment	$\pm 1\%$ of range	Recalibrate. If problem persists, replace standard solution. Recalibrate.	Program Manager, QA Officer
Hydrolab DataSonde 4a: Turbidity	A-2	Prior to deployment	$\pm 5\%$ of range	Recalibrate. If problem persists, clean lenses, ensure fresh standard solution. Recalibrate.	Program Manager, QA Officer

Based on EPA-NE Worksheet #14

11.4 Field Analytical Instrument/Equipment Maintenance, Testing, and Inspection Requirements

This section describes the procedures and documentation activities that will be performed to ensure that all field analytical instrumentation and equipment are available and in working order when needed.

All instruments are inspected and tested during February, March, and April of each monitoring year to ensure proper functionality. Instruments are cleaned and calibrated according to manufacturer's specifications, and placed concomitantly in a sample chamber (e.g., bucket) to determine instrument agreement.

All field instruments are visually inspected by the by the Program Manager or QA Officer prior to use during the sampling season. Visual inspection occurs by the volunteer monitors prior to each use, and periodic inspections occur by the VRAP intern during field TSAs. This includes an inspection of sensors, cables and associated connections to meters, corrosion at cable and/or battery ports, battery power capacity, etc. Any problems identified during the visual inspection are reconciled prior to instrument use.

Individual instrument maintenance/inspection logs are maintained on loose-leaf paper for each volunteer group. The logs are stored in a clear plastic bag (e.g., Ziploc®) in each field kit (i.e., toolbox, which contains the water quality instrumentation) during the summer months, and subsequently filed in respective group file folders at the Water Quality Planning Section Office in Concord after the conclusion of the monitoring period. The log is arranged in columnar format, with column headings of date of inspection/maintenance, name of instrument, description of problem/maintenance activity, and description of problem reconciliation.

Field instruments are maintained (cleaned) and tested according to manufacturer's specifications (Appendix A). Procedures used to test instruments are those used to calibrate the instruments. Any instruments that are not properly calibrated are re-calibrated according the SOPs. If the second calibration is inadequate, corrective measures are employed, as shown in Table 15.

11.5 Field Analytical Inspection and Acceptance Requirements for Supplies

Instrumentation reagents such as pH buffers, dissolved oxygen electrolytes, analytical standards are retained with all water quality instrumentation throughout the sampling season. Acceptance requirements directly relate to the expiration dates stamped on reagent bottles, where reagents are discarded if the expiration data has passed. The VRAP intern, Program Manager, or QA Officer replenishes all reagents on a biweekly basis. However, volunteer monitors may request a replenished stock of reagents if the reagents appear discolored or are otherwise contaminated within the biweekly period. All field analytical equipment and appurtenant supplies are inspected according to methods described throughout Section 11 and associated Appendices.

Table 15. Field Analytical Equipment Maintenance, Testing, and Inspection

Equipment name	Activity	Frequency of activity	Acceptance criteria	Corrective action	Person responsible	SOP Reference (Appendix)
YSI Model 95: Dissolved oxygen and temperature	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year ^a , or as needed during sampling season	$\pm 0.2\text{mg/l}$ or $\pm 2\%$ of saturation, whichever is greater	Replace membrane, batteries; repair cables; clean ports; Recalibrate; Repeat measurement of affected samples or qualify data if analysis cannot be repeated.	Volunteer Monitors, Program Manager	A-1
Orion Model 210A and ATC Triode Model 91- 57BN	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year ^a , or as needed during sampling season	Slope Range: 92-102%; millivolt range consistent with manufacturer's specifications	Recalibrate according to SOP. If still unacceptable, use new buffer and recalibrate.	Volunteer Monitors, Program Manager	A-1
YSI Model 30: Specific Conductance	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year ^a , or as needed during sampling season	Instrument agreement: ± 6.0 $\mu\text{S/cm}$ at specific conductance near $500 \mu\text{S/cm}$; $\pm 3.0 \mu\text{S/cm}$ at specific conductance below $200 \mu\text{S/cm}$	Turn meter "off". Check batteries, check cord and ports, rinse with deionized water. Turn meter "on". If problems persist, use alternate meter.	Volunteer Monitors, Program Manager	A-1
LaMotte Model 2020: Turbidity	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year ^a , or as needed during sampling season	Instrument agreement: ± 1.0 NTU	Inspect sample vials; wash and/or replace, if necessary. Inspect standard. Inspect battery power.	Volunteer Monitors, Program Manager	A-1
Hydrolab DataSonde 4a: Dissolved Oxygen and Temperature	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year ^a , or as needed during sampling season	$\pm 0.2\text{mg/l}$ or $\pm 2\%$ of saturation, whichever is greater	Replace membrane, batteries; repair cables; clean ports; Recalibrate; Repeat measurement of affected samples or qualify data if analysis cannot be repeated.	Volunteer Monitors, Program Manager	A-2
Hydrolab DataSonde 4a: pH	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year ^a , or as needed during sampling season	Slope Range: 92-102%; millivolt range consistent with manufacturer's specifications	Recalibrate according to SOP. If still unacceptable, use new buffer and recalibrate.	Volunteer Monitors, Program Manager	A-2
Hydrolab DataSonde 4a: Specific Conductance	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year ^a , or as needed during sampling season	Instrument agreement: ± 6.0 $\mu\text{S/cm}$ at specific conductance near $500 \mu\text{S/cm}$; $\pm 3.0 \mu\text{S/cm}$ at specific conductance below $200 \mu\text{S/cm}$	Turn meter "off". Check batteries, check cord and ports, rinse with deionized water. Turn meter "on". If problems persist, use alternate meter.	Volunteer Monitors, Program Manager	A-2
Hydrolab DataSonde 4a: Turbidity	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year ^a , or as needed during sampling season	Instrument agreement: ± 1.0 NTU	Inspect sample vials; wash and/or replace, if necessary. Inspect standard. Inspect battery power.	Volunteer Monitors, Program Manager	A-2

Based on EPA-NE Worksheet #19

^aBefore commencement and at conclusion of summer sampling season

12.0 Fixed Laboratory Analytical Method Requirements

This section describes the analytical techniques used by the NHDES Laboratory Services Unit to generate data for VRAP. This section does not include details of other laboratories used in VRAP; requisite information is documented in annual SAPs developed by the individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office. Methods are analytical techniques used to identify and quantify the target analytes. Analytical SOPs document how the laboratory will perform a specific analytical method.

12.1 Fixed Laboratory Analytical Methods and SOPs

The Laboratory Services Unit uses various analytical instrumentation and associated SOPs, referenced in Table 16, below, and in the Quality Systems Manual on file with DES and EPA-NE. Information from other laboratories is documented in annual SAPs developed by the individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office. A summary of methods is also provided in Table 7. Sample custody, data documentation, and data management procedures are described in Section 10.2 and 10.3 of this QA Project Plan.

Table 16. Fixed Laboratory Analytical Method/SOP Reference Table

Analytical parameter	Reference Number (Appendix)	SOP Title and Revision date/number Name of lab	Instrument
TP	A-3	State of NH Environmental Services Laboratory: Total Phosphorus, Lachat Flow Injection Colorimetry Revision No. 2.1 Revision Date: 02-03-03	Lachat Flow Injection Analyzer
NO ₃ +NO ₂	A-4	State of NH Environmental Services Laboratory: Lachat Flow Injection Anions: Nitrate, Nitrite, Chloride, and Fluoride (automated Nitrite) Revision No. 2.2 Revision Date: 02-11-03	Lachat Flow Injection Analyzer
TKN	A-5	State of NH Environmental Services Laboratory: Total Kjeldahl Nitrogen, TKN by flow injection colorimetry Revision No. 2.3 Revision Date: 04-25-03	Lachat Flow Injection Analyzer
NH ₃	A-6	State of NH Environmental Services Laboratory: Ammonia by flow injection colorimetry Revision No. 2.2 Revision Date: 02-14-03	Lachat Flow Injection Analyzer
Hardness	A-7	State of NH Environmental Services Laboratory: Metals by ICP for public drinking water Revision No. 2.0 Revision Date: 01-17-03	ICP
Alkalinity	A-8	State of NH Environmental Services Laboratory: Alkalinity Revision No. 5.0	pH Meter- Orion 710A and Brinkman Digital Buret

Analytical parameter	Reference Number (Appendix)	SOP Title and Revision date/number Name of lab	Instrument
		Revision Date: 01-10-03	
TS	A-9	State of NH Environmental Services Laboratory: Total Residue Revision No. 1.5 Revision Date: 01-17-03	Gooches, drying oven, analytical balance
TSS	A-10	State of NH Environmental Services Laboratory: Total non-filterable residue (suspended solids) Revision No. 1.7 Revision Date: 01-21-03	Gooches, drying oven, analytical balance
BOD ₅	A-11	State of NH Environmental Services Laboratory: Biochemical oxygen demand Revision No. 2.5 Revision Date: 01-10-03	Membrane electrode
<i>E. coli</i>	A-12	State of NH Environmental Services Laboratory: <i>Escherichia coli</i> (<i>E. coli</i>) by membrane filtration Revision No. 1.4 Revision Date: 02-13-03	Membrane Filter assembly
Aluminum	A-7	State of NH Environmental Services Laboratory: Metals by ICP for public drinking water Revision No. 2.0 Revision Date: 01-17-03	ICP
Copper	A-13	State of NH Environmental Services Laboratory: Metals by ICP-MS for public drinking water Revision No. 0.5 Revision Date: 01-17-03	ICP-MS
Lead	A-13	State of NH Environmental Services Laboratory: Metals by ICP-MS for public drinking water Revision No. 0.5 Revision Date: 01-17-03	ICP-MS
Zinc	A-13	State of NH Environmental Services Laboratory: Metals by ICP-MS for public drinking water Revision No. 0.5 Revision Date: 01-17-03	ICP-MS
Chlorophyll <i>a</i>	A-14	State of NH Limnology Center Laboratory: Chlorophyll <i>a</i> Revision Date: 05-25-01	Integrated sampler

Based on EPA-NE Worksheet #20

12.2 Fixed Laboratory Analytical Method/SOP Modifications

Modifications to the fixed laboratory analytical methods/SOPs are not made for VRAP during the sampling period.

12.3 Fixed Laboratory Instrument Calibration

The NHDES Laboratory Services Unit calibrates all instruments on a daily basis according to SOPs referenced in Table 17, below. Information from other laboratories is documented in annual SAPs developed by the individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office.

Table 17. Fixed laboratory instrument calibration table

Equipment name and Analyte	Procedure and SOP Reference	Frequency of calibration	Acceptance criteria	Corrective action	Person responsible
Lachat Flow Injection Analyzer TP Lachat QuikChem Method 10-115-01-1-F	EPA 365.2, DES 10.20a	daily	cal curve corr. coeff. \geq 0.995	If < 0.995, re-calibrate	Analyst, supervisor
Lachat Flow Injection Analyzer NO ₃ +NO ₂ Lachat 10-107-04-1-A	EPA 353.2, DES 10.15f	daily	cal curve corr. coeff. \geq 0.995	If < 0.995, re-calibrate	Analyst, supervisor
Lachat Flow Injection Analyzer TKN Lachat Method #10-107-06-2-E	EPA 351.2, DES 10.16c	daily	cal curve corr. coeff. \geq 0.995	If < 0.995, re-calibrate	Analyst, supervisor
Lachat Flow Injection Analyzer NH ₃ Lachat Method #10-107-06-1-A	EPA 350.1, DES 10.14c	daily	cal curve corr. coeff. \geq 0.995	If < 0.995, re-calibrate	Analyst, supervisor
ICP Al, Hardness	EPA 200.7, DES Sec 10.12c1	daily	cal curve corr. coeff. \geq 0.995	If < 0.995, re-calibrate	Analyst, supervisor
pH Meter- Orion 710A and Brinkman Digital Buret Alkalinity	EPA 310.1, DES 10.01a	daily pH meter	pH 7 QC= 6.95 to 7.05	re calibrate	Analyst, supervisor
Gooches, drying oven, analytical balance TS	EPA 160.3 DES 10.21	daily balance check	balance weights must comply with weight tolerances in table ^b	re-calibrate balance if possible, see trouble-shooting guide, call for service	QA officer
Gooches, drying oven, analytical balance TSS	EPA 160.2, DES 10.23	daily balance check	balance weights must comply with weight tolerances in table ^a	re-calibrate balance if possible, see trouble-shooting guide, call for service	QA officer
Orion Model 860 Dissolved Oxygen Meter with Probe BOD ₅	EPA 405.1, DES 10.02	daily	slope=0.90-1.15	re-calibrate, check probe	Analyst, supervisor
Membrane Filter assembly	SM 9213D.3, 10.43d	N/A	N/A	N/A	N/A

Equipment name and Analyte	Procedure and SOP Reference	Frequency of calibration	Acceptance criteria	Corrective action	Person responsible
<i>E. coli</i>					
ICP-MS Cu, Pb, Zn	EPA 200.8, DES 10.12d	daily	cal curve corr. coeff. \geq 0.995	If < 0.995, re- calibrate	Analyst, supervisor

Based on EPA-NE Worksheet #21

^aBalance Weight Tolerances (see Table 16-A)

Table 18. Acceptable Ranges for Balance Weight Tolerances.

Target Weight (g)	Tolerance Criteria (g)	Agreement Percentage
0.002	0.0018-0.0022	$\pm 10\%$
0.02	0.0198-0.0202	$\pm 1\%$
0.05	0.0495-0.0505	$\pm 1\%$
0.1	0.0999-0.1001	$\pm 0.1\%$
0.5	0.4995-0.5005	$\pm 0.1\%$
1	0.999-1.001	$\pm 0.1\%$
5	4.995-5.005	$\pm 0.1\%$
10	9.99-10.01	$\pm 0.1\%$
20	19.98-20.02	$\pm 0.1\%$
30	29.97-30.03	$\pm 0.1\%$
50	49.95-50.05	$\pm 0.1\%$
100	99.9-100.1	$\pm 0.1\%$
300	299.7-300.3	$\pm 0.1\%$

12.4 Fixed Laboratory Instrument/ Equipment Maintenance, Testing and Inspection Requirements

The NHDES Laboratory is a USEPA certified laboratory, and accredited by the National Environmental Laboratory Accreditation Conference (NELAC) in September 2001. Accreditation audits were conducted according to the NELAC constitution bylaws and standards dated July 1999 by Charles Dyer (NH Environmental Lab Accreditation Program Manager) and Arthur Clark (EPA-NE).

All instrumentation is inspected prior to use according to methods outlined in the SOPs for individual parameters/instruments. All maintenance activities are documented in maintenance logs. All records of the laboratory audit, including the laboratory instrument/equipment maintenance, testing, and inspection requirements, are available through the NHDES QA Officer or EPA-NE.

Information for laboratories other than NHDES is documented in annual SAPs developed by the individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office.

12.5 Fixed Laboratory Inspection and Acceptance Requirements for Supplies

All supplies purchased or otherwise acquired by the NHDES Laboratory are inspected prior to use, with purchases being made from reputable companies. Supplies are of adequate quality to sustain confidence in laboratory tests. All supplies must meet bid specifications before being purchased for laboratory use. The laboratory inspects consumables, where practicable, for compliance with standard specifications relative to testing criteria. The NHDES Accounts Payable section of Administrative Services retains records of all purchases for a period of seven years. Chemical purchases are documented in each analytical test preparation book as they are put into service.

The reagent water source is a Millipore Milli-RX Reverse Osmosis / ELIX System that produces high-quality Type II water with resistivity > 15 megOhms. The system is maintained under a service contract with Millipore.

13.0 Quality Control Requirements

This section of the QAPP documents the QC procedures, checks, samples, and acceptance limits used for VRAP.

13.1 Sampling Quality Control

The individual volunteer groups collect duplicate samples and take replicate measurements throughout the sampling period. At least 10% of all samples and measurements are duplicates and replicates.

- A. For field duplicates, a second sample is collected (1) concomitant with the final sample of any particular sampling day, or (2) every tenth sample, whichever is first. For example, if eight samples are collected for total phosphorus during a sampling day, a duplicate sample is collected with the eighth sample. However, if 12 samples are collected for total phosphorus during the day, duplicate samples are collected with the tenth and twelfth samples.
- B. For field measurement replicates, a second measurement is made (1) concomitant with the final sample of any particular sampling day, or (2) every tenth sample, whichever is first. For example, if eight dissolved oxygen measurements are made during a sampling day, two sequential measurements are made for the eighth measurement. However, if 12 dissolved oxygen measurements are made during the day, two sequential measurements are made with the tenth and twelfth measurements.

Duplicate samples are accepted during sampling if (1) each of the two sample collection containers (i.e., sampling buckets) are filled at least one-half of their capacities, and (2) samples are appropriately transferred from each of the buckets to the sample storage containers. Duplicate samples are sometimes collected repeatedly from the same sampling station, since the number of stations is less than the frequency of sampling.

Upon receipt of samples at the NHDES Laboratory, a laboratory staff member measures the temperature of the water sample using an infrared thermometer and records the temperature on a login form. This eliminates the need for cooler temperature blanks. Following analysis, all results are transmitted to the Program Manager. The Program Manager accepts laboratory results only if (1) the sample temperature upon receipt at the laboratory approximates the requisite parameter-specific storage temperature (e.g., 1-6°C), or (2) a short time span existed between sample collection and sample receipt to preclude acclimation to the requisite parameter-specific storage temperature. The Program Manager contacts the Laboratory QA Officer to for additional consultation, if necessary.

Sampling quality control procedures for other laboratories are documented in annual SAPs developed by the individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office.

13.2 Analytical Quality Control

This section of the QAPP identifies the QC procedures, checks, and samples, and their respective acceptance limits that will be used during the project

13.2.1 Field Analytical QC

Field duplicate samples are collected and measurement replicate measurements are made for all field parameters, as described in Section 13.1, above (Table 19). Turbidity and specific conductance measurements are verified through comparisons with field blanks, whereas pH measurements are verified using a known buffer (e.g., pH = 6.0). Dissolved oxygen measurements are verified by comparing the

percent of saturation prior to the measurement (i.e., calibration value) with the percent of saturation after the measurement. The percent of saturation after the measurement should not be more than 2% higher or lower than the initial calibration value. Data retention for water quality assessment purposes is contingent on compliance with a parameter-specific relative percent difference (RPD) as described in Section 7.2 of this QAPP.

Table 19. Field Analytical QC Sample Table.

Water Quality Parameter	QC Check ^a	QC Acceptance Limit	Corrective Action	Person Responsible for Corrective Action	Data Quality Indicator
Temperature	Field duplicate; Measurement replicate	± 0.2 °C	Repeat measurement	Volunteer Monitors or Program Manager	Precision
Dissolved Oxygen	Field duplicate; Measurement replicate	± 2% of saturation, or ± 0.2 mg/l	Recalibrate instrument, repeat measurement	Volunteer Monitors or Program Manager	Precision
	Instrument blank ^b	± 2% of saturation, or ± 0.2 mg/l	Recalibrate instrument, repeat measurement	Volunteer Monitors or Program Manager	Relative accuracy
pH	Field duplicate; measurement replicate	± 0.1 std units	Recalibrate instrument, repeat measurement	Volunteer Monitors or Program Manager	Precision
	Known buffer (pH = 6.0)	± 0.1 standard units	Recalibrate instrument repeat measurement	Volunteer Monitors or Program Manager	Accuracy
Specific Conductance	Field duplicate; measurement replicate	± 30 µS/cm	Recalibrate instrument, repeat measurement	Volunteer Monitors or Program Manager	Precision
	Method blank	± 5.0 µS/cm	Recalibrate instrument, repeat measurement	Volunteer Monitors or Program Manager	Accuracy
Turbidity	Field duplicate; measurement replicate	± 0.1 NTU	Recalibrate instrument, repeat measurement	Volunteer Monitors or Program Manager	Precision
	Method blank	± 0.1 NTU	Recalibrate instrument, repeat measurement	Volunteer Monitors or Program Manager	Accuracy

^aperformed on a frequency of one per sampling day per parameter, or every tenth sample for each parameter, whichever is first

^binstrument blank = replacing sensor in storage chamber and recording measurement, with subsequent comparison to initial calibration value

13.2.2 Fixed Laboratory QC

Laboratory QC is achieved through various checks, as summarized in Table 20 through Table 34. Complete descriptions for the NHDES laboratory, including acceptance criteria, are provided in parameter-specific SOPs in Appendix A. Precision calculations in the laboratory are derived from duplicate sample analysis, where duplicate sample frequency varies according to analyte (e.g., one duplicate for every eight total phosphorus samples). Precision is expressed as ranges (i.e., calculation of difference between actual sample and duplicate sample). Information from other laboratories is documented in annual SAPs developed by the individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office.

Table 20. NHDES Laboratory Analytical QC: Total Phosphorous (TP)

Analytical Method/SOP Reference: Appendix A-3		Measurement Performance Criteria: <u>EPA 365.2 by Lachat 10-115-01-1-F</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	1 at beginning, end and every 10 samples	0 to <MDL	Invalidate the run and repeat	Analyst, Inorganic Supervisor, Quality Control Supervisor	Contamination, drift, method performance
Reagent Blank	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA
Laboratory Duplicates	1 every 10 samples	Range: 0 – 0.009	Repeat, qualify data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Precision
Laboratory Matrix Spike	1 every 10 samples	86-117%	Repeat, qualify data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Matrix effect
Laboratory Control Sample	1/run	0.100 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy
Laboratory Fortified Blank	1/run	0.05 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy, method performance
Continuing Calibration Verification (mid-point calibration standard)	1 every 10 samples	0.200 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Drift

Based on EPA-NE QAPP worksheet #24a

Table 21. NHDES Laboratory Analysis QC: Nitrate and Nitrite (NO₃ + NO₂)

Analytical Method/SOP Reference: Appendix A-4		Measurement Performance Criteria: <u>EPA 353.2 by Lachat 10-107-04-1-A</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	NA	NA	NA	NA	NA
Reagent Blank	1 at beginning, end, and every 10 samples	0 to <MDL	Invalidate run and repeat	Analyst, Inorganic Supervisor, Quality Control Supervisor	Drift, contamination, method performance
Instrument Blank	NA	NA	NA	NA	NA
Laboratory Duplicates	1 every 10 samples	0 – 0.03mg/l	Repeat, quantify data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Precision
Laboratory Matrix Spike	1 every 10 samples	90-110%	Repeat, quantify data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Matrix interference
Laboratory Control Sample	1/run	2.5 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy
Laboratory Fortified Blank	1/run	1.5 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Method Performance/ Accuracy
Continuing Calibration Verification (mid-point calibration standard)	1 every 10 samples	6.25 +/- 10%	Re-run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Method Performance/ Accuracy

Based on EPA-NE QAPP worksheet #24a

Table 22. NHDES Laboratory Analysis QC: Total Kjeldahl Nitrogen (TKN)

Analytical Method/SOP Reference: Appendix A-5		Measurement Performance Criteria: <u>EPA 351.2 by Lachat 10-107-06-2-E</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	1 at beginning, end and every 10 samples	0 to <MDL	Invalidate run and repeat	Analyst, Inorganic Supervisor, Quality Control Supervisor	Contamination, method performance, drift
Reagent Blank	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA
Laboratory Duplicates	1 every 10 samples	0 – 0.33 mg/l	Repeat, qualify data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Precision
Laboratory Matrix Spike	1 every 10 samples	78-123%	Repeat, qualify data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Matrix /effect
Laboratory Control Sample	1/run	3.5 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy
Laboratory Fortified Blank	1/run	1.0 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy and method performance
Continuing Calibration Verification (mid-point calibration standard)	1 every 10 samples	2.0 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy and method performance

Based on EPA-NE QAPP worksheet #24a

Table 23. NHDES Laboratory Analysis QC: Ammonia (NH₃-N)

Analytical Method/SOP Reference: Appendix A-6		Measurement Performance Criteria: <u>Standard Methods # 4500NH₃-B.& G</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	1 at beginning, end and every 10 samples	Must be: 0 to <MDL	Invalidate data run and repeat	Analyst, Inorganic Supervisor, Quality Control Supervisor	Method performance contamination drift
Reagent Blank	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA
Laboratory Duplicates	1 every 10 samples	0 – 0.32 mg/l	Re-run, qualify data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Precision
Laboratory Matrix Spike	1 every 10 samples	Recovery: 84 – 110%	Re-run, qualify data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Matrix effects (interference)
Laboratory Control Sample	1/run	4.11(+/- 10%) 8.22 (+/- 10%)	Re-analyze a fresh aliquot or Re-run whole run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy
Laboratory Fortified Blank	1/run	1.0 +/- 10%	Re-analyze a fresh aliquot or Re-run whole run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy and methods performance
Continuing Calibration Verification (mid-point calibration standard)	1 every 10 samples	10 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy and methods performance

Based on EPA-NE QAPP worksheet #24a

Table 24. NHDES Laboratory Analysis QC: Hardness

Analytical Method/SOP Reference: Appendix A-7		Measurement Performance Criteria: <u>EPA 200.7</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	NA				
Reagent Blank	beginning, end, and every 10 samples	<RDL	re-cal, re-run	analyst, Inorganics supervisor, QAO	contamination, drift
Instrument Blank	NA				
Laboratory Duplicates	1 in 10 samples duplicated	range 0-2.26 mg/L	repeat sample qualify data	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	1 in 10 samples spiked	88-111%	repeat sample qualify data	analyst, Inorganics supervisor, QAO	matrix effects
LCS 38.2mg/L	1 per run	+/-10% 34.4-42.0	re-cal, re-run	analyst, Inorganics supervisor, QAO	accuracy
LFB 53.2 mg/L	1 per run	+/-10% 51.3-57.8	re-cal, re-run	analyst, Inorganics supervisor, QAO	method performance

Based on EPA-NE QAPP worksheet #24a

Table 25. NHDES Laboratory Analysis QC: Alkalinity

Analytical Method/SOP Reference: Appendix A-8		Measurement Performance Criteria: <u>EPA 600/4-79-020, Method 310.1;</u> <u>Standard Method 2320 B (APHA, 1995)</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	NA				
Reagent Blank	beginning of run	<RDL	re-run	analyst, Inorganics supervisor, QAO	contamination, drift
Instrument Blank	NA				
Laboratory Duplicates	1 in 10 samples duplicated	range 0-0.44	repeat sample	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	NA				
LCS 50 mg/L	beginning and every 10 samples	+/-10% 45.0-55.0	re-cal, re-run	analyst, Inorganics supervisor, QAO	accuracy
LFB	NA				

Based on EPA-NE QAPP worksheet #24a

Table 26. NHDES Laboratory Analysis QC: Total Solids (TS)

Analytical Method/SOP Reference: Appendix A-9		Measurement Performance Criteria: <u>EPA 600/4-79-020, Method 160.3;</u> <u>Standard Method 2540 B (APHA, 1995)</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	1 per run, in duplicate	± 5 mg/L	correct results based on blank	analyst, Inorganics supervisor, QAO	drying effectiveness, method performance
Reagent Blank	NA				
Instrument Blank	NA				
Laboratory Duplicates	1 in samples duplicated	20% RPD	repeat sample qualify data	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	NA				
LCS-level varies per lot	1 per run	90-110%	repeat run	analyst, Inorganics supervisor, QAO	accuracy
LFB	NA				

Based on EPA-NE QAPP worksheet #24a

Table 27. NHDES Laboratory Analysis QC: Total Suspended Solids (TSS)

Analytical Method/SOP Reference: Appendix A-10		Measurement Performance Criteria: <u>Standard Methods 2540 D</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	1 per run, in duplicate	± 5 mg/L	correct results based on blank	analyst, Inorganics supervisor, QAO	drying effectiveness, method performance
Reagent Blank	NA				
Instrument Blank	NA				
Laboratory Duplicates	1 in samples duplicated	20% RPD	repeat sample qualify data	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	NA				
LCS-level varies per lot	1 per run	90-110%	repeat run	analyst, Inorganics supervisor, QAO	accuracy
LFB	NA				

Based on EPA-NE QAPP worksheet #24a

Table 28. NHDES Laboratory Analysis QC: Biochemical Oxygen Demand (BOD₅)

Analytical Method/SOP Reference: Appendix A-11		Measurement Performance Criteria: <u>Standard Methods # 5210B</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	NA	NA	NA	NA	NA
Reagent Blank (Dilution Water)	1/run	<0.2 mg/l	Report qualified data or invalidate data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Contamination
Instrument Blank	NA	NA	NA	Na	NA
Laboratory Duplicates	1/batch	Range: 0-0.86 mg/l	Report qualified data or invalidate data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Precision
Laboratory Matrix Spike	1/batch per matrix	Recovery: 77-135%	Report qualified data or invalidate data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Interferences
Laboratory Control Sample	1/batch	LCS = 3.4 +/- 10%	Report qualified data or invalidate data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy
Laboratory Fortified Blank	NA	NA	NA	NA	NA
Bottle Blank	1/run	<2 mg/l	Report qualified data or invalidate data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Contamination

Based on EPA-NE QAPP worksheet #24a

Table 29. NHDES Laboratory Analysis QC: *E. coli*

Analytical Method/SOP Reference: Appendix A-12		Measurement Performance Criteria: <u>Membrane Filter Procedure, EPA 600/4-85/076; Standard Method 9213D.3 (APHA, 1995)</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	beginning, end, every 10 samples	No growth	request resamples	microbiology supervisor, QAO	contamination
Reagent Blank	NA				
Instrument Blank	NA				
Laboratory Duplicates	about 5%	not established			precision
Laboratory Matrix Spike	NA				
Laboratory Control Sample	NA				
Laboratory Fortified Blank	NA				

Based on EPA-NE QAPP worksheet #24a

Table 30. NHDES Laboratory Analysis QC: Aluminum (Al)

Analytical Method/SOP Reference: Appendix A-7		Measurement Performance Criteria: <u>EPA 200.7</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	NA				
Reagent Blank	beginning, end, and every 10 samples	<RDL	re-cal, re-run	analyst, Inorganics supervisor, QAO	contamination, drift
Instrument Blank	NA				
Laboratory Duplicates	1 in 10 samples duplicated	range 0-0.024	repeat sample qualify data	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	1 in 10 samples spiked	91-106%	repeat sample qualify data	analyst, Inorganics supervisor, QAO	matrix effects
ICV 2.0 mg/L	1 per run	+/-10% 1.80-2.20	re-cal, re-run	analyst, Inorganics supervisor, QAO	accuracy
LFB 0.500 mg/L	1 per run	+/-10% 0.450-0.550	re-cal, re-run	analyst, Inorganics supervisor, QAO	method performance

Based on EPA-NE QAPP worksheet #24a

Table 31. NHDES Laboratory Analysis QC: Copper (Cu)

Analytical Method/SOP Reference: Appendix A-13		Measurement Performance Criteria: <u>EPA 200.8</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	NA				
Reagent Blank	beginning, end, and every 10 samples	<RDL	re-cal, re-run	analyst, Inorganics supervisor, QAO	contamination, drift
Instrument Blank	NA				
Laboratory Duplicates	1 in 10 samples duplicated	duplicate range +/-10%	Laboratory Duplicates	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	1 in 10 samples spiked	85-110%	Laboratory Matrix Spike	analyst, Inorganics supervisor, QAO	matrix effects
ICV 0.020 mg/L	1 per run	+/-10% 0.018-0.022	ICV 0.020 mg/L	analyst, Inorganics supervisor, QAO	accuracy
LFB 0.050 mg/L	1 per run	+/-10% 0.045-0.055	re-cal, re-run	analyst, Inorganics supervisor, QAO	method performance

Based on EPA-NE QAPP worksheet #24a

Table 32. NHDES Laboratory Analysis QC: Lead (Pb)

Analytical Method/SOP Reference: Appendix A-13		Measurement Performance Criteria: <u>EPA 200.8</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	NA				
Reagent Blank	beginning, end, and every 10 samples	<RDL	re-cal, re-run	analyst, Inorganics supervisor, QAO	contamination, drift
Instrument Blank	NA				
Laboratory Duplicates	1 in 10 samples duplicated	duplicate range 0-0.003 mg/L	repeat sample qualify data	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	1 in 10 samples spiked	85-110%	repeat sample qualify data	analyst, Inorganics supervisor, QAO	matrix effects
ICV 0.020 mg/L	1 per run	+/-10% 0.018-0.022	re-cal, re-run	analyst, Inorganics supervisor, QAO	accuracy
LFB 0.050 mg/L	1 per run	+/-10% 0.045-0.055	re-cal, re-run	analyst, Inorganics supervisor, QAO	method performance

Based on EPA-NE QAPP worksheet #24a

Table 33. NHDES Laboratory Analysis QC: Zinc (Zn)

Analytical Method/SOP Reference: Appendix A-13		Measurement Performance Criteria: <u>EPA 200.8</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	NA				
Reagent Blank	beginning, end, and every 10 samples	<RDL	re-cal, re-run	analyst, Inorganics supervisor, QAO	contamination, drift
Instrument Blank	NA				
Laboratory Duplicates	1 in 10 samples duplicated	duplicate range 0-0.009 mg/L	repeat sample qualify data	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	1 in 10 samples spiked	79-103%	repeat sample qualify data	analyst, Inorganics supervisor, QAO	matrix effects
ICV 0.020 mg/L	1 per run	+/-10% 0.018-0.022	re-cal, re-run	analyst, Inorganics supervisor, QAO	accuracy
LFB 0.050 mg/L	1 per run	+/-10% 0.045-0.055	re-cal, re-run	analyst, Inorganics supervisor, QAO	method performance

Based on EPA-NE QAPP worksheet #24a

Table 34. NHDES Laboratory Analysis QC: Chlorophyll *a* (Chlor *a*)

Analytical Method/SOP Reference: Appendix A-14		Measurement Performance Criteria: <u>No Reference in Standard Methods</u>		Number of Samples: <u>See Annual SAP</u>	
Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptable Limits	Corrective Action (CA)	Person(s) Responsible For CA	Data Quality Indicator (DQI)
Method Blank	10% or weekly	>MDL	Inspect bottles and filtering equipment for contamination	Analyst	Accuracy/Bias (contamination)
Reagent Blank	NA	NA	NA	NA	NA
Instrument Blank	One per analytical shift	N/A	Instrument Correction	Instrument	Accuracy/Bias (contamination)
Laboratory Duplicates	10%	+/- 3 ug/L	Review Bench book sample information	Analyst	Analytical Precision
Calibration Verification Check (Turner Low Cal Standard)	Quarterly	+/- 10%	Reanalyze standard	Analyst	Accuracy/Bias
Calibration Verification Check (NIST Test # SRM2031)	Annual	Within Manufacturer's Tolerance(s)	Adjust as required to meet manufacturer's specifications and tolerances	QAQC Officer	Accuracy/Bias

Based on EPA-NE QAPP worksheet #24a

* Note: The entire sample is used when performing this analysis. Thus, recourse does not exist for laboratory duplicates that do not meet an acceptance limit; invalidate/exclude the data.

14.0 Data Acquisition Requirements

This section of the QAPP identifies the sources of previously collected data and other information that will be used to make project decisions.

Data from other programs, such as the NHDES Ambient River Monitoring Program (ARMP), may be used for selecting sampling locations (Table 35). It should be noted that these data are used for guidance purposes only, as reviewed by the Program Manager or other Water Quality Planning Section staff.

Data collected by volunteer monitors are primarily used for public education purposes, but are also used for DES surface water quality assessments (i.e., 305(b) report and 303(d) list). Formal criteria for using VRAP data in DES surface water quality assessments are described in the NHDES Comprehensive Listing and Assessment Methodology (CALM).

Although data collected through VRAP are the primary data sources used for project decisions, other data are collected during the year through other DES water quality programs: (1) surface water quality complaint investigations, (2) Section 401 Water Quality Certificate conditions, and (3) Total Maximum Daily Load (TMDL) studies. These data are acquired directly through the Water Quality Planning Section, and are used for reference in the context of newly collected VRAP data. Ancillary information is also derived from photographs, topographic maps, and Geographic Information System (GIS) thematic layers. Similarly, this information is used for reference only.

Table 35. Non-Direct Measurements Criteria and Limitations Table.

Non-direct measurement (secondary data)	Data source, report date, data generator, data collection dates	How data will be used	Limitations on data use
Surface Water Quality Data	NHDES Volunteer River Assessment Program: 1998-2002	Determine need for additional sampling and/or sampling locations	Dependent on applicable QA/QC and SOPs
Surface Water Quality Data	NHDES Ambient River Monitoring Program (ARMP): 1989-2002	Determine need for additional sampling and/or sampling locations	Data age ≤ five years

Based on EPA-NE Worksheet #25

15.0 Documentation, Records and Data Management

This section of the QAPP describes how project data and information will be documented, tracked, and managed from the field to final use and storage in a manner that ensures data integrity and defensibility.

15.1 Project Documentation and Records

VRAP includes several modes of documentation (Table 36), and an Oracle-based, STORET-compatible database is used to retain data in the NHDES Watershed Management Bureau.

Table 36. Project Documentation and Records Table.

Sample Collection Records	Field Analysis Records	Fixed Laboratory Records	Data Assessment Records
Field Data Sheets	Station Identification Forms	Login and Custody Sheets	Signed Field Data Sheets
GIS Maps	Field Data Sheets	Laboratory Bench Books (NHDES only)	Field audit checklists
	Equipment Maintenance, Testing, and Inspection Log	Laboratory Results Printouts (raw data)	

Based on EPA-NE Worksheet #26

15.2 Field Analysis Data Package Deliverables

Field analytical data represent definitive data for VRAP, although the data are subject to QA/QC review. Field measurements (e.g., dissolved oxygen, temperature, etc.) are made concomitantly at the time samples are collected for laboratory analysis. Similarly, at the time of sampling, volunteer monitors are encouraged to document any station-specific characteristics (e.g., general in-channel, riparian, and/or upland attributes). Field measurement data and sampling station attribute data are recorded on field data sheets and station identification forms. These documents reside in individual volunteer group file folders, and constitute the field analysis data package, which is retained in the Water Quality Planning Section office.

15.3 Fixed Laboratory Data Package Deliverables

Fixed laboratory data represent definitive data for VRAP, although the data are subject to QA/QC review. The NHDES Laboratory Services Unit provides typed, tabular-formatted analytical results sheets to the Program Manager. Data are also electronically transferred from the laboratory database to the water quality database. Although the laboratory analyses are conducted according to sample holding times, the analytical results are typically transmitted within six months after sample collection. Other laboratories also provide typed, tabular-formatted analytical results sheets, which are typically submitted to the Program Manager by the volunteer groups. The results sheets from all laboratories constitute the fixed laboratory data package, which is retained in the Water Quality Planning Section office.

15.4 Data Reporting Formats

Volunteer monitors are encouraged to use ink to document all field data and information (field measurements, station descriptions, etc.). However, documents completed with pencil or other erasable

media are acceptable. Volunteer monitors are also encouraged to correct all recording errors by placing a single horizontal line through the error, recording the new data next to or above the erroneous record(s), and initialing the correction. Field measurement data are entered manually into the NHDES water quality database, whereas laboratory analytical results are entered into the LIMS database.

15.5 Data Handling and Management

VRAP includes field measurements and laboratory analyses of water quality. If applicable, station descriptions accompany the field measurements. Field measurement data are recorded on field data sheets, transmitted to the Program Manager, and retained in individual file folders for each volunteer group. Throughout the sampling period, field measurement data are entered into the NHDES water quality database, after review by the Program Manager. All data entered into the database are cross-checked against the data on the field data sheets by a second staff member to eliminate data entry errors; data entry errors are immediately corrected.

Laboratory results from the NHDES laboratory are hand-written in bench books, and are subsequently entered into the Laboratory Information Management System (LIMS) database by laboratory personnel. Data handling and management procedures by other laboratories are documented in annual SAPs developed by the individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office. Results from all laboratories are submitted to the Program Manager for review and entry into the NHDES water quality database. Results are subsequently cross-checked against the data on the results sheets to eliminate data entry errors; data entry errors are immediately corrected.

All data are entered, processed, and analyzed using personal computers supporting the Microsoft (MS) suite of software programs. The NHDES water quality database is an Oracle-based application maintained on the NHDES computer network, which is secured through daily back-up procedures. Charts, tables, figures, and descriptive statistics (e.g., mean, maximum, minimum, etc.) are generated using MS Excel. Raw data are codified accordingly for use in binomial statistical analysis. Raw data are also extracted from the NHDES water quality database to support the development of the 303(d) list and 305(b) report.

A copy of the field data sheet, station identification form, laboratory login/custody sheet, and NHDES laboratory results sheet are provided in Appendix C.

15.6 Data Tracking and Control

The Program Manager tracks all field and laboratory data collected under VRAP throughout the sampling period. Laboratory personnel track laboratory-specific data. The field data sheets are relinquished to the Program Manager for review on an approximate bi-weekly basis. Results from the NHDES laboratory are transferred to bench books, and, subsequently, to the LIMS by laboratory personnel immediately following analysis. Data tracking and control procedures by other laboratories are documented in annual SAPs developed by the individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office. The results are subsequently relinquished to the Program Manager for entry into the NHDES water quality database. The field data sheets and laboratory results sheets are retained in the Water Quality Planning Section office. All data remain secure in the LIMS and NHDES water quality databases, which are maintained on the NHDES computer network. Access to the computer network is restricted to staff of the NHDES. Data are retrieved through the use of the query options provided by the database software by the Program Manager and Water Quality Planning Section staff.

16.0 Assessments and Response Actions

This section of the QAPP identifies the number, frequency, and type of planned assessment activities that will be performed for the project.

16.1 Planned Assessments (Audits)

VRAP supports water quality monitoring programs of numerous volunteer groups throughout the state. Therefore, technical systems audits (TSA) are required for ensuring data quality. The audits are conducted on the individual volunteer groups at least once during the sampling period for (1) water sample collection, (2) operation of instrumentation, and (3) data documentation, where the Program Manager, QA Officer, or VRAP intern accompany the volunteer monitors in the field during water sampling. An assessment/audit sheet is used to document the activity (Appendix C). A formal TSA for data entry is conducted twice, according to the data entry schedule, where the Program Manager or QA Officer oversees the VRAP intern as data are input to the database.

A formal TSA for all activities is not conducted at the onset of the monitoring season, as an initial training session ensures proper use of instrumentation prior to the sampling period. During the TSAs (except for the training session), the Program Manager, QA Officer, or VRAP intern and the volunteer monitors discuss the efficiency and effectiveness of the VRAP protocols. Any substantive changes to the protocols are made consistent with section 4.2.1 of this QAPP.

Planned assessments are not conducted in the NHDES laboratory for data collected specifically for VRAP. However, proficiency testing, replicate testing, and re-testing of retained samples are among the attributes of the laboratory performance audits that are conducted throughout the year. Assessments by other laboratories are documented in annual SAPs developed by the individual volunteer groups and the Program Manager; the SAPs are retained at the VRAP office.

Quality Assurance System Program Self Audits are conducted annually for the general operation of VRAP, pursuant to Chapter 9 and Chapter 10 of the DES Quality Management Plan (QMP). These assessments document the deviations, if any, between the operation of VRAP during any particular year, and the consistency with the approved QAPP. The results of the self-audits are transmitted to the DES QA Manager prior to January 31 of the following year for any given monitoring period.

Table 37. Project Assessment Table.

Assessment Type	Frequency	Person(s) responsible for performing assessment, title and organizational affiliation	Person(s) responsible for responding to assessment findings, title and organizational affiliation	Person (s) responsible for identifying and implementing corrective actions (CA), title and organizational affiliation	Person (s) responsible for monitoring effectiveness of CA, title and organizational affiliation
Field Sampling TSA	Minimum of once during the sampling period	Program Manager, QA Officer, or VRAP Intern: NHDES	Program Manager or QA Officer: VRAP NHDES	Program Manager or QA Officer: VRAP NHDES	Program Manager or QA Officer: VRAP NHDES
Field Analytical TSA	Minimum of once during the sampling period	Program Manager, QA Officer, or VRAP Intern: NHDES	Program Manager or QA Officer: VRAP NHDES	Program Manager or QA Officer: VRAP NHDES	Program Manager or QA Officer: VRAP NHDES

Assessment Type	Frequency	Person(s) responsible for performing assessment, title and organizational affiliation	Person(s) responsible for responding to assessment findings, title and organizational affiliation	Person (s) responsible for identifying and implementing corrective actions (CA), title and organizational affiliation	Person (s) responsible for monitoring effectiveness of CA, title and organizational affiliation
NHDES Laboratory Services Fixed Laboratory TSA	Annually in September	Rachael Rainey DES Laboratory QA/QC Officer NHDES	Rachael Rainey DES Lab QA/QC Officer NHDES	Rachael Rainey DES Laboratory QA/QC Officer NHDES	Rachael Rainey DES Laboratory QA/QC Officer NHDES
NHDES Program Self-Audit	Annually during fall of any given year	Program Manager or QA Officer	Program Manager or QA Officer	Program Manager or QA Officer	Vincent Perelli NHDES Quality Assurance Manager

Based on EPA-NE Worksheet #27b

16.2 Assessment Findings and Corrective Action Responses

Following the completion of field TSAs, the Program Manager and/or QA Officer identifies any/all inconsistencies between the QAPP and the actual performance of methods outlined in this QAPP and associated SOPs. The Program Manager and/or QA Officer determines the magnitude of the inconsistencies, and determines the potential for substantive error generated by the inconsistencies. Subsequently, the Program Manager either conditionally retains the data or removes the data from the water quality assessment. The Program Manager also determines (1) whether the QAPP and/or SOPs should be revised due to inefficiency, or (2) whether volunteer monitors require additional training.

Following the completion of laboratory TSAs, the laboratory QA/QC officer identifies discrepancies related to the analytical procedures are recorded on the bench log or data package. The laboratory QA/QC Officer subsequently reviews the bench logs, data package, and Corrective Action forms, and electronically retains Corrective Action forms.

16.3 Additional QAPP Non-Conformances

The Program Manager and/or QA Officer is notified of any QAPP inconsistencies, and implements necessary corrective actions as soon as possible after identification of the non-conformance. Depending on the magnitude of the non-conformance or the probability for substantive error, the Program Manager determines (1) whether the QAPP and/or SOPs should be revised due to inefficiency, or (2) whether field technicians require additional training. Any changes to this QAPP, as identified as necessary by the Program Manager, are conducted according to Section 4.2 of this QAPP.

17.0 QA Management Reports

Routine Quality Assurance (QA) Management Reports are not written for VRAP, although an annual QA memorandum is written at the conclusion of the data collection period (i.e., September/October) (Table 38). This memorandum summarizes the QA activities conducted during that particular year, including

- Summary of QA/QC objectives;
- Description of training activities;
- Conformance to QAPP requirements/procedures, and descriptions of deviations, if any, from the approved QAPP and approved amendments, if any, to the QAPP;
- Limitations of data;
- Documentation of usable data versus amount of data actually collected;
- List of reasons why data are not usable. This includes a review of any of the following
 - Precision
 - Accuracy
 - Representativeness
 - Completeness
 - Comparability
 - Sensitivity
- Summary of conflicts, and subsequent resolution of conflicts, associated with sampling; and
- Use and effectiveness of corrective actions, if corrective actions were taken.

Copies of the memorandum are retained in the VRAP files for reference when preparing the 303(d) list and 305(b) report. Copies are also transmitted to the NHDES Quality Assurance Manager. VRAP data are consistently reviewed during the sampling period to determine sampling efficiency.

Quality Assurance System Program Self Audits are conducted annually for the general operation of VRAP, pursuant to Chapter 9 and Chapter 10 of the DES Quality Management Plan (QMP). These assessments document the deviations, if any, between the operation of VRAP during any particular year, and the consistency with the approved QAPP. The results of the self-audits are transmitted to the DES QA Manager prior to January 31 of the following year for any given monitoring period.

Table 38. QA Management Reports Table

Type of report	Frequency	Person responsible for report prep (name & org.)	Report recipients	Projected delivery date
VRAP audit memorandum	Annual	Ted Walsh, NHDES	NHDES-WMB files;	October 31 of each year
NHDES Program Self-Audit	Annual	Ted Walsh, NHDES	NHDES Quality Assurance Manager	January 31 of each year

Based on EPA-NE Worksheet #28

18.0 Verification and Validation Requirements

VRAP supports water quality monitoring programs of numerous volunteer groups throughout the state, where the data are used to (1) generate water quality reports for the individual volunteer groups, and (2) support the development of the 303(d) list and 305(b) report. Therefore, data verification and validation are required for ensuring data quality. All field data, laboratory data, and appurtenant documentation are verified and validated prior to use in water quality reports and surface water quality assessments. However, verification and validation need not be conducted by external entities. The field data collection and field and laboratory data entry activities associated with VRAP are subject to verification and validation reviews by the Program Manager and/or QA Officer, whereas the analytical procedures performed in the laboratory are verified and validated by the Laboratory QA Manager. Specific procedures are provided in Section 19.0.

19.0 Verification and Validation Procedures

This section of the QAPP describes the process that will be followed to verify and validate project data.

19.1 Verification

Throughout the monitoring period, verification reviews for field-based activities are conducted by the Program Manager to ensure data are collected in accordance with this QA Project Plan and appurtenant SOPs (Table 39). This is achieved through the completion of a verification log on a monthly basis. The log is signed and dated by the Program Manager to indicate proper documentation of meter calibration data, documentation of data collected during sampling, and appropriate reconciliation of documentation errors during calibration and field activities. At the conclusion of the monitoring period, verification reviews are conducted by the Program Manager to ensure consistency between laboratory samples submitted and laboratory data received. The Program Manager signs and dates the log to indicate consistency. A copy of the log sheet is provided in Appendix C.

Verification procedures for laboratory-based activities, including transfer of sample custody, are documented in the NHDES Laboratory Services Unit Quality Systems Manual (QSM). A formal checklist is not used in VRAP. The QSM is on file with EPA-NE.

Table 39. Data Verification Process

Verification task	Description	Person responsible for verification (name, organization)
Sampling Design	Conformance to the sampling design is verified approximately bi-weekly, after the volunteer monitors transmit data sheets to the Program Manager. This includes a comparison of the sampling activities planned for the day against the sampling activities actually conducted. Any inconsistencies are discussed and reconciled prior to the subsequent sampling event, if the subsequent sampling day is impacted by the inconsistency. A log is signed, dated, and retained in the VRAP files.	Program Manager NHDES
Field Data Sheets	Field data and instrument calibration data are verified approximately bi-weekly, where completeness and adherence to error reconciliation procedures are the primary concerns. The verification review is conducted after volunteer monitors transmit data sheets to the Program Manager. Requisite corrective actions are imposed prior to the subsequent sampling event, if necessary. A log is signed, dated, and retained in the VRAP files.	Program Manager NHDES
Sample Handling	The transfer of custody of each water sample is verified as part of the consistency determination conducted for Laboratory Analysis, and is described, below.	Program Manager NHDES
Laboratory Analysis	Laboratory data packages are verified internally for completeness prior to transmittal, in accordance with the NHDES Laboratory Services Unit QSM. Verification also includes a consistency determination to ensure that the laboratory transmits results of all samples submitted during the monitoring period. A log is signed, dated, and retained in the VRAP files.	Laboratory QA Manager NHDES Program Manager NHDES

Based on EPA-NE Worksheet #29a

19.2 Validation

VRAP requires several individual validation events relative to the occurrence of Program activities. Validation reviews are conducted internally on an as-needed basis during the sampling period, relative to data sheet submittals by the volunteer monitors period basis. Validation is documented through use of a log (Appendix C).

19.2.1 Field Data

Validation reviews for field-generated data are conducted after each volunteer group completes its sampling event (approximately bi-weekly). The Program Manager reviews calibration data and field sampling data (dissolved oxygen, temperature, pH, specific conductance, turbidity) to ensure data are within the anticipated limits (e.g., pH values must not exceed 14 standard units). The Program Manager screens the data, and discusses any potential outliers with the volunteer monitors. The Program Manager validates the data collected for the individual sampling events by signing the validation log.

Validation reviews for field-generated data are also conducted throughout the monitoring season as data entry activities are conducted. The Program Manager screens the data, and discusses any potential inaccuracies with the VRAP intern. The Program Manager validates the data entered by the VRAP intern by signing a log.

19.2.2 Laboratory Data

Validation reviews for NHDES laboratory-generated data are conducted by NHDES Laboratory Services personnel under the supervision of the Laboratory QA Manager, according to methods described in the NHDES Laboratory Services Unit QSM. In addition, after transmittal of laboratory data to the VRAP Manager, a validation review is conducted for any potential outliers. The Program Manager contacts the Laboratory QA Manager to reconcile any inaccuracies. After the conclusion of the monitoring season, the Program Manager authorizes other NHDES Watershed Management Bureau staff to input data to the database. The Program Manager screens the data, and discusses any potential inaccuracies with staff responsible for data entry. The Program Manager validates the data entered by signing a log.

20.0 Data Usability/Reconciliation with Project Quality Objectives

The usability of validated project data is determined through statistical calculations and numerical comparisons with the measurement performance criteria and project quality objectives discussed in Section 7 of this QAPP. The usability assessment is conducted after the conclusion of the sampling period to consider the overall performance of the sampling effort. The Program Manager conducts the assessment, and provides tabular, graphical, and textual documentation regarding data quality and usability based on the measures described, below. All data that exceed the limits defined by the individual measures are acknowledged in the data tables through highlighting or shading.

Precision: Field and laboratory-derived data are subject to comparison with duplicate samples throughout the monitoring period. The data must meet the analytical ranges and RPD values defined in Table 6 of Section 7.2.1. As stated in Section 7.2.1, the RPD for field duplicates is determined as

$$(1) \quad RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100\%$$

where x_1 is the original sample concentration
 x_2 is the duplicate sample concentration

Accuracy/Bias: Field and laboratory-derived data are subject to comparison with blank and spiked samples throughout the monitoring period. Data from blank and spike samples are compared with the accuracy limits defined in Table 6 of Section 7.2.1.

Sample Representativeness: Field and laboratory data are reviewed relative to the original sampling design. Field sampling audits are used to document representativeness.

Sensitivity and quantitation limits: All field and laboratory data are reviewed relative to the prescribed limits defined in Section 7 of this QAPP.

Completeness: All field and laboratory-derived results are summed to determine the actual number of results obtained relative to the number of results expected, as documented in the original sampling schedule. The difference between the results obtained versus the results expected is documented.

Comparability: All field and laboratory-derived data are assumed comparable unless otherwise determined by the Program Manager and/or NHDES Laboratory QA Officer. This assumption is based on the use of consistent field sampling and field analytical procedures, and consistent laboratory analytical procedures. Any procedural or protocol deviations are reported to the Program Manager.

Data Limitations and Actions: Any data exceeding the limits of the individual measures, above, are disqualified from surface water quality assessments. These data serve as guidance for future monitoring efforts, where the sampling locations from which these data were collected are targeted for additional sampling. The Program Manager reviews all exceedences and determines the need for revisions to the sampling and/or analytical approaches.

21.0 References

U.S. EPA-New England, Region I. 1999. Compendium of Quality Assurance Project Plan Requirements and Guidance. U.S. EPA-New England, Boston, MA.